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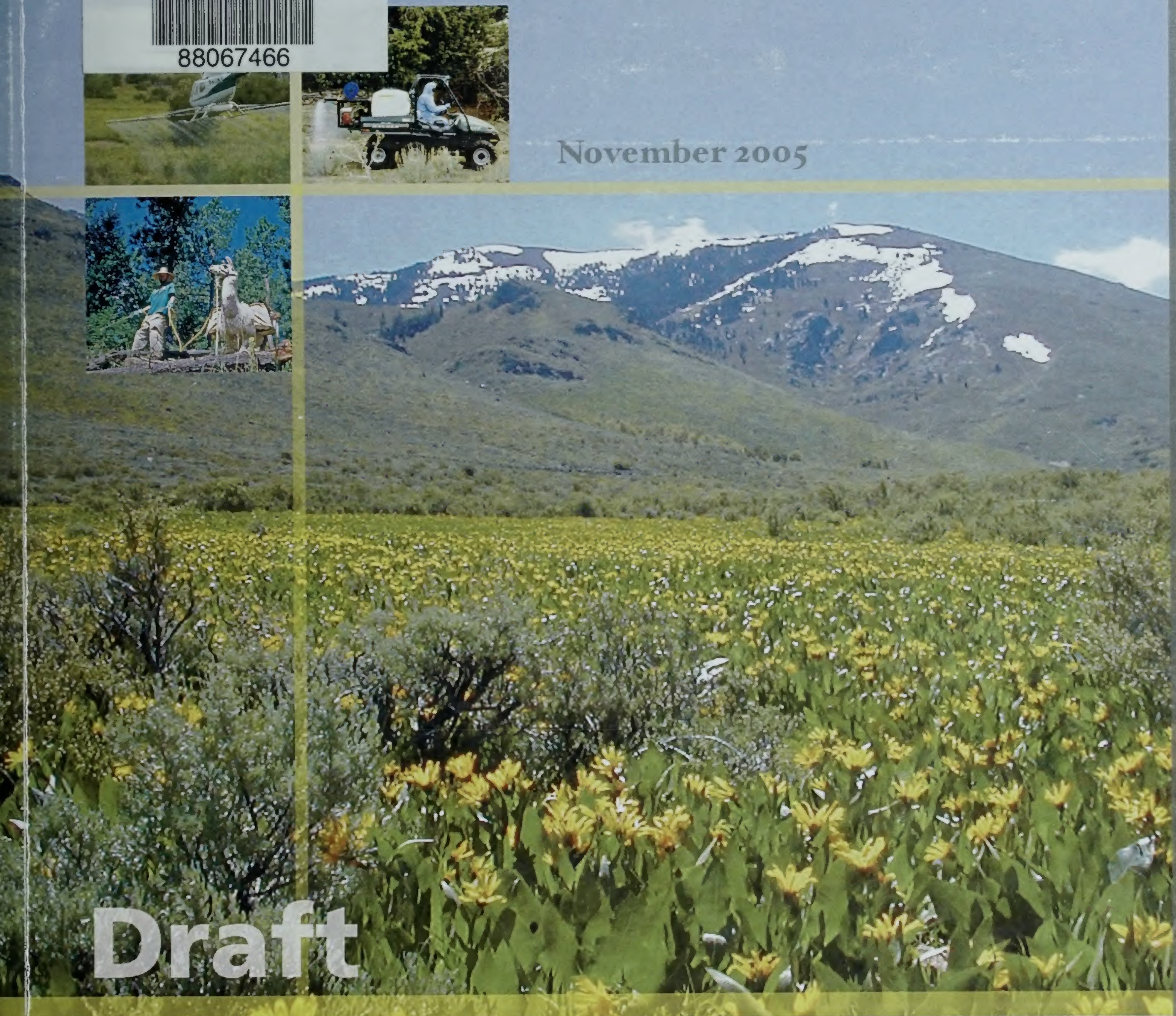

November 2005

Draft

Vegetation Treatments Using Herbicides

on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Impact Statement

Volume 2: Appendixes

U.S. Department of the Interior
Bureau of Land Management

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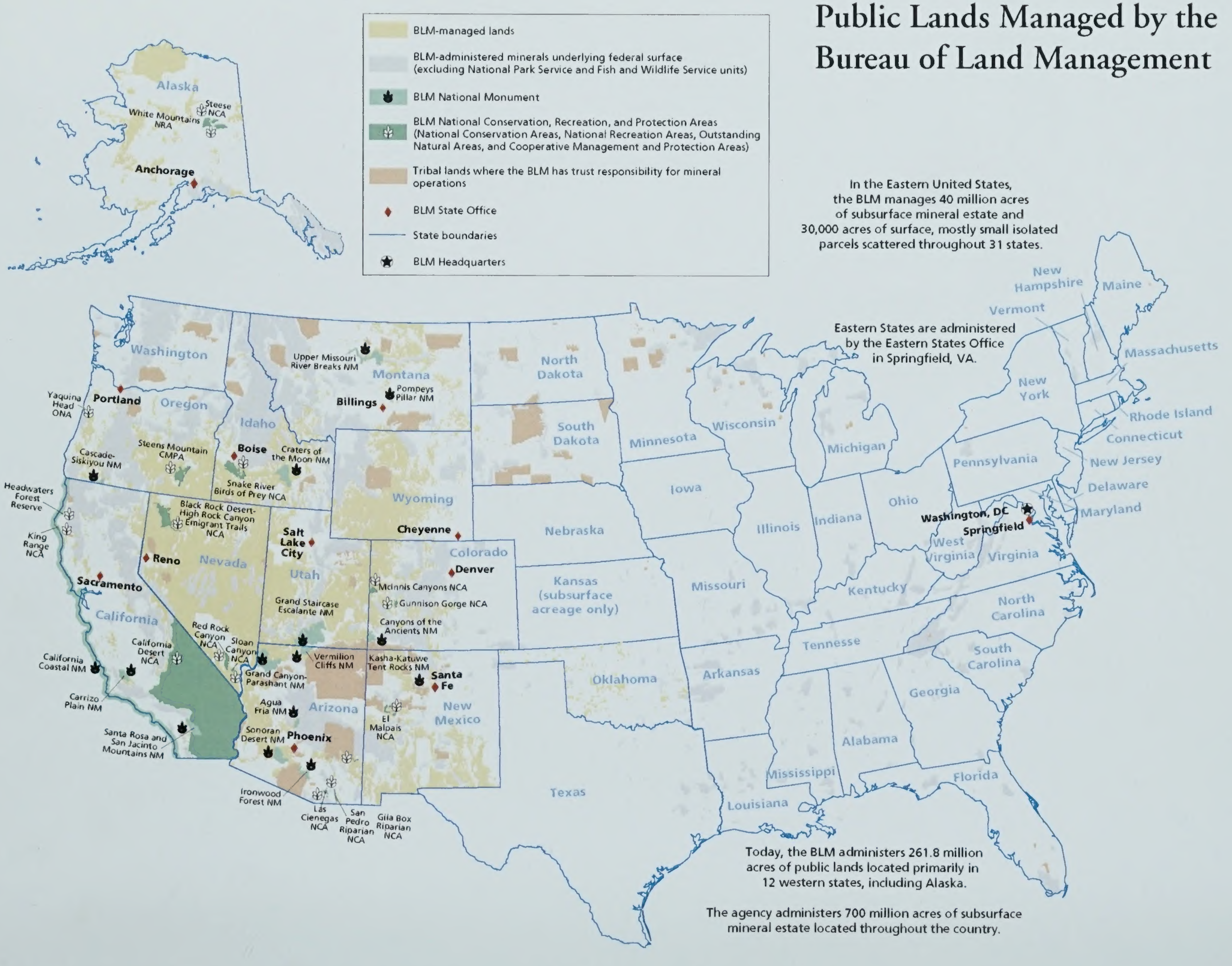

Appendices

Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States

Volume 2

Prepared by

Bureau of Land Management

Nevada State Office

Reno, Nevada

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VOLUME 2

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COMMON AND SCIENTIFIC NAMES OF PLANTS AND ANIMALS GIVEN IN THE PROGRAMMATIC EIS

APPENDIX A

COMMON AND SCIENTIFIC NAMES OF PLANTS AND ANIMALS GIVEN IN THE PROGRAMMATIC EIS

This appendix contains a list of the common and scientific names of vegetation and wildlife species mentioned in the text of the EIS.

Common Name	Scientific Name
PLANTS	
Grasses	
Barley, Wild	*Hordeum spontaneum*
Beachgrass, European	*Ammophila arenaria*
Beargrass	*Nolina* spp.
Bluegrass	*Poa* spp.
Bluegrass, Sandberg's	*Poa secunda*
Bluestem	*Andropogon* spp.
Bluestem, Cane	*Bothriochloa barbinodis*
Brome, Downy	*Bromus tectorum*
Brome, Foxtail	*Bromus rubens*
Brome, Japanese	*Bromus japonicus*
Brome, Red	*Bromus rubens*
Brome, Ripgut	*Bromus rigidus*
Brome, Soft	*Bromus mollis*
Buffalograss	*Buchloe dactyloides*
Buffelgrass	*Pennisetum ciliare*
Bunchgrass	*Agropyron* spp.
Canarygrass, Reed	*Phalaris arundinacea*
Cheatgrass	*Bromus tectorum*
Chess, Soft	*Bromus hordeaceus*
Clover,	*Trifolium* spp.
Clover, Burr	*Medicago polymorpha*
Cordgrass	*Spartina* spp.
Cottongrass	*Eriophorum* spp.
Fescue, Idaho	*Festuca idahoensis*
Fescue, Rough	*Festuca campestris*
Filaree, Broadstem	*Erodium botrys*
Filaree, Redstem	*Erodium cicutarium*
Grama, Black	*Bouteloua eriopoda*
Grama, Blue	*Bouteloua gracilis*
Grama, Hairy	*Bouteloua hirsute*
Grama, Sideoats	*Bouteloua curtipendula*
Grass, Galleta	*Pleuraphis* spp.
Grass, Giant Reed	*Phragmites australis*
Grass, Pappus	*Pappophorum* spp.
Lovegrass, Plains	*Eragrostis intermedia*

Common Name	Scientific Name
PLANTS (Cont.)	
Mediterranean grass	*Schismus barbatus*
Medusahead	*Taeniatherum caput-medusae*
Mullein, Turkey	*Eremocarpus setigerus*
Needlegrass	*Achnatherum* spp.
Needlegrass, Purple	*Nassella pulchra*
Oat, Slender	*Avena barbata*
Oat, Wild	*Avena fatua*
Reed	*Phragmites* sp.
Reed, Giant	*Arundo donax*
Ricegrass, Indian	*Oryzopsis hymenoides*
Saltgrass, Inland	*Distichlis spicata*
Squirreltail, Bottlebrush	*Elymus elymoides*
Tanglehead	*Heteropogon contortus*
Threeawns	*Aristida* spp.
Threeawns, Prairie	*Aristida oligantha*
Tobosagrass	*Pleuraphis mutica*
Wheatgrass, Bluebunch	*Pseudoroegneria spicata*
Wheatgrass, Western	*Pascopyrum smithii*
Wildrye, Great Basin	*Leymus cinereus*
Wolftail	*Lycurus setosus*
Forbs and Nonvascular Plants	
Amaranth	*Amaranthus* spp.
Arrowweed	*Pluchea sericea*
Bindweed, Field	*Convolvulus arvensis*
Bitterroot	*Lewisia* spp.
Cattail	*Typha* spp.
Cinquefoil	*Potentilla* spp.
Cinquefoil, Shrubby	*Dasiphora floribunda*
Cocklebur	*Xanthium* spp.
Cress, Hoary	*Cardaria draba*
Halogeton	*Halogeton glomeratus*
Hogfennel	*Peucedanum praeruptorum*
Horsetail	*Equisetum* spp.
Houndstongue	*Cynoglossum officinale*
Hyacinth, Water	*Eichhornia crassipes*
Hydrilla	*Hydrilla* sp.
Kelp, Bull	*Nereocystis luetkeana*
Knapweed, Diffuse	*Centaurea diffusa*
Knapweed, Meadow	*Centaurea pratensis*
Knapweed, Russian	*Acroptilon repens*
Knapweed, Spotted	*Centaurea maculosa*
Knapweed, Squarrose	*Centaurea virgata*
Knotweed, Japanese	*Polygonum cuspidatum*
Kochia	*Kochia scoparia*
Lily, Water	*Nymphaea* spp.
Milkweed, Whorled	*Asclepias verticillata L.*
Moss, Sphagnum	*Sphagnum cymbifolium*
Liverwort	*Marchantia polymorpha*
Lomatium	*Lomatium* spp.
Loosestrife, Purple	*Lythrum salicaria*
Mustard, Wild	*Brassica kaber*

Common Name	Scientific Name
PLANTS (Cont.)	
Nettle, Stinging	*Urtica dioica*
Pepperweed, Perennial	*Lepidium latifolium*
Pigweed	*Amaranthus* spp.
Plantain	*Plantago* spp.
Ragweed	*Ambrosia* spp.
Ragweed, Canyon	*Ambrosia ambrosioides*
Rosemary, Bog	*Andromeda polifolia*
Salvinia, Giant	*Salvinia molesta*
Skeletonweed, Rush	*Chondrilla juncea*
Snakeweed	*Gutierrezia* spp.
Spurge, Leafy	*Euphorbia esula*
St. Johnswort, Common	*Hypericum perforatum*
Star-thistle, Maltese	*Centaurea melitensis*
Star-thistle, Yellow	*Centaurea solstitialis*
Tansy, Common	*Tanacetum vulgare*
Tansy, Mustard	*Descurainia* spp.
Tansy, Ragwort	*Senocio jacobaea*
Teasel	*Dipsacus fullonum*
Thistle, Bull	*Cirsium vulgare*
Thistle, Canada	*Cirsium arvense*
Thistle, Musk	*Carduus nutans*
Thistle, Russian	*Salsola kali*
Thistle, Scotch	*Onopordum acanthium*
Toadflax	*Linaria* spp.
Toadflax, Dalmation	*Linaria genistifolia dalmatica*
Toadflax, Yellow	*Linaria vulgaris*
Watermilfoil, Eurasian	*Myriophyllum spicatum*
Yellowhead, Desert	*Yermo xanthocephalus*
Shrubs and Trees	
Acacia, Catclaw	*Acacia greggii*
Acacia, Whitethorn	*Acacia constricta*
Agave	*Agave* spp.
Alder, Red	*Alnus rubra*
Alder, Green	*Alnus viridis*
Allthorn	*Koeberlinia* spp.
Ash	*Fraxinus* spp.
Aspen	*Populus* spp.
Aspen, Quaking	*Populus tremuloides*
Azaleas, Western	*Rhododendron occidentalis*
Birch (Arctic), Dwarf	*Betula nana*
Birch, Paper	*Betula papyrifera*
Bitterbrush	*Purshia* spp.
Bitterbrush, Antelope	*Purshia tridentata*
Blackberry	*Rubus* spp.
Blueberry	*Vaccinium* spp.
Blueberry, Dwarf	*Vaccinium caespitosum*
Buckthorn, Hollyleaf	*Rhamnus crocea*
Burroweed	*Isocoma tenuisecta*
Bursage	*Ambrosia* spp.
Bush, Creosote	*Larrea tridentata*

Common Name	Scientific Name
PLANTS (Cont.)	
Cactus, Prickly Pear	*Opuntia* spp.
Cactus, Saguaro	*Carnegia gigantea*
Ceanothus, Desert	*Ceanothus greggii*
Ceanothus, Snowbrush	*Ceanothus velutinous*
Ceanothus, Wedgeleaf	*Ceanothus cuneatus*
Cedar, Eastern Red	*Juniperus virginana*
Cedar, Western Red	*Thuja plicata*
Chamise	*Adenostoma fasciculatum*
Chokecherry	*Prunus virginiana*
Cholla	*Opuntia imbricata*
Christmasberry	*Crossopetalum ilicifolium*
Cliffrose	*Purshia* spp.
Cottonwood, Black	*Populus balsamifera*
Cranberry, Bog	*Oxycoccus oxycoccos*
Crowberry	*Empetrum* spp.
Cypress, Monterey	*Cupressus macrocarpa*
Devil's Club	*Oplopanax horridus*
Elderberry	*Sambucus* spp.
Elm	*Ulmus* spp.
Fern, Bracken	*Pteridium aquilinum*
Fir, Balsam	*Abies balsamea*
Fir, Corkbark	*Abies lasiocarpa*
Fir, Douglas-	*Pseudotsuga menziesii*
Fir, Red	*Abies magnifica*
Fir, Silver	*Abies alba*
Fir, Subalpine	*Abies lasiocarpa*
Fir, White	*Abies concolor*
Gorse	*Ulex europaeus*
Greasewood	*Sarcobatus vermiculatus*
Hackberry	*Celtis* spp.
Hemlock, Mountain	*Tsuga mertensiana*
Hemlock, Poison	*Conium maculatum*
Hemlock, Western	*Tsuga heterophylla*
Hopsage	*Grayia* spp.
Hopsage, Spiny	*Grayia spinosa*
Horsebrush	*Tetradymia* spp.
Huckleberry	*Gaylussacia* spp.
Huckleberry, California	*Vaccinium ovatum*
Incense-cedar	*Calocedrus decurrens*
Indianhemp	*Apocynum cannabinum*
Ironwood, Desert	*Olneya tesota*
Jojoba	*Simmondsia chinensis*
Joshua Tree	*Yucca brevifolia*
Juniper	*Juniperus* spp.
Juniper, Alligator	*Juniperus deppeana*
Juniper, Oneseed	*Juniperus monosperma*
Juniper, Rocky Mountain	*Juniperus scopulorum*
Juniper, Utah	*Juniperus osteosperma*
Juniper, Western	*Juniperus occidentalis*
Kinnikinnick	*Arctostaphylos uva-ursi*

Common Name	Scientific Name
PLANTS (Cont.)	
Larch	*Larix* spp.
Larch, Western	*Larix occidentalis*
Laurel, California	*Umbellularia californica*
Live Oak, Canyon	*Quercus chrysolepis*
Live Oak, Coast	*Quercus agrifolia*
Live Oak, Evergreen	*Quercus virginiana*
Live Oak, Interior	*Quercus wislizeni*
Madrone, Pacific	*Arbutus menziesii*
Mallow, Round-leaved	*Malva pusilla*
Manzanita	*Arctostaphylos* spp.
Manzanita, Pointleaf	*Arctostaphylos pungens*
Manzanita, Pringle	*Arctostaphylos pringlei*
Maple, Rocky Mountain	*Acer glabrum*
Maple, Vine	*Acer circinatum*
Mesquite	*Prosopis* spp.
Mesquite, Curly	*Hilaria belangeri*
Mesquite, Honey	*Prosopis juliflora*
Mesquite, Vine	*Panicum obtusum*
Mimosa	*Mimosa pudica*
Muhly, Bush	*Muhlenbergia porteri*
Mountain Mahogany	*Cercocarpus* spp.
Oak, Blue	*Quercus douglasii*
Oak, Bur	*Quercus macrocarpa*
Oak, California Black	*Quercus kelloggii*
Oak, California Scrub	*Quercus berberidifolia*
Oak, Emory	*Quercus emoryi*
Oak, Gambel	*Quercus gambelii*
Oak, Gray	*Quercus grisea*
Oak, Oregon White	*Quercus garryana*
Oak, Poison	*Toxicodendron* spp.
Oak, Shinnery	*Quercus harardii*
Oak, Valley	*Quercus lobata*
Ocotillo	*Fouquieria splendens*
Olive, Russian	*Elaeagnus angustifolia*
Oregon Grape	*Mahonia* spp.
Oxytrope, Blackish	*Oxytropis nigrescens*
Palo Verde, Blue	*Parkinsonia florida*
Pine, Bishop	*Pinus muricata*
Pine, Bristlecone	*Pinus aristata*
Pine, Coulter	*Pinus coulteri*
Pine, Digger	*Arceuthobium occidentale*
Pine, Jeffrey	*Pinus jeffreyi*
Pine, Limber	*Pinus flexilis*
Pine, Lodgepole	*Pinus contorta*
Pine, Monterey	*Pinus radiata*
Pine, Ponderosa	*Pinus ponderosa*
Pine, Sugar	*Pinus lambertiana*
Pine, Torrey	*Pinus torreyana*
Pine, Western White	*Pinus monticola*
Pine, Whitebark	*Pinus albicaulis*

Common Name	Scientific Name
PLANTS (Cont.)	
Pinyon	*Pinus edulis*
Pinyon, Double Leaf	*Pinus edulis*
Pinyon, Mexican	*Pinus cembroides*
Pinyon, Single Leaf	*Pinus monophylla*
Poplar, Balsam	*Populus balsamifera*
Rabbitbrush	*Chrysothamnus* spp.
Rabbitbrush, Rubber	*Ericameria nauseosa*
Red Fir, California	*Abies magnifica*
Rhododendron, Pacific	*Rhododendron macrophyllum*
Sagebrush	*Artemisia* spp.
Sagebrush, Big	*Artemisia tridentate*
Sagebrush, Black	*Artemisia nova*
Salal	*Gaultheria shallon*
Saltbush	*Atriplex* spp.
Saltbrush, Shadescale	*Atriplex confertifolia*
Saltcedar	*Tamarix ramosissima*
Scale, All	*Atriplex polycarpa*
Scotch Broom	*Cytisus scoparius*
Sequoia, Giant	*Sequoiadendron giganteum*
Serviceberry	*Amelanchier arborea*
Silktassel, Yellowleaf	*Garrya flavescens*
Smoketree	*Cotinus coggygria*
Snowberry	*Symphoricarpos albus*
Soapberry	*Sapindus* spp.
Sorrel, Redwood	*Oxalis oregano*
Spruce, Black	*Picea mariana*
Spruce, Engelmann	*Picea engelmannii*
Spruce, Sitka	*Picea sitchensis*
Spruce, White	*Picea glauca*
Sumac	*Rhus* spp.
Swordfern	*Polystichum munitum*
Tanoak	*Lithocarpus densiflorus*
Tarbush	*Flourensia cernua*
Tea, Labrador	*Ledum* spp.
Tea, Mormon	*Ephedra viridis*
Thornbush	*Lycium fremontii*
Twinflower	*Linnaea borealis*
Willow	*Salix* spp.
Willow, Desert	*Chilopsis linearis*
White Pine, Western	*Pinus monticola*
Yellow-cedar, Alaska	*Chamaecyparis nootkatensis*
Yucca	*Yucca* spp.
INVERTEBRATES	
Beetle, Black-margined Loosestrife	*Galerucella calmariensis*
Beetle, Golden Loosestrife	*Galerucella pusilla*
Bug, Pirate	*Lyctocoris campestris*
Earthworm	*Oligochaeta* spp.
Flea, Water	*Cladoceran* spp
Flea, Water	*Daphnia magna*
Lacewing, Green	*Chrysoperla rufilabris*

Common Name	Scientific Name
INVERTEBRATES (Cont.)	
Midge	Tendipedidae
Mosquitoe	*Ochlerotatus* spp.
Scud, Water	*Hyallela* spp.
Shrimp, Glass	*Palaemonetes kadiakensis*
Slug, Banana	*Ariolimax columbianus*
Weevil, Blunt Loosestrife Seed	*Nanophyes brevis*
Weevil, Loosestrife Root	*Hylobius transversovittatus*
Weevil, Salvinia	*Cyrtobagous salviniae*
FISH	
Bass	*Micropterus* spp.
Bass, Largemouth	*Micropterus salmoides*
Bass, Smallmouth	*Micropterus dolomieu*
Bonytail	*Gila elegans*
Candlefish	*Thaleichthys pacificus*
Carp	*Cyprinus* spp.
Catfish, Channel	*Ictalurus punctatus*
Chub, Bonytail	*Gila elegans*
Chub, Humpback	*Gila cypha*
Chub, Sicklefin	*Macrhybopsis meeki*
Chub, Sturgeon	*Macrhybopsis gelida*
Crappie, White	*Pomoxis annularis*
Dace, Foskett Speckled	*Rhinichthys osculus*
Minnow, Fathead	*Pimephales promelas*
Pike, Northern	*Esox lucius*
Pikeminnow, Colorado	*Ptychocheilus lucius*
Pupfish	*Cyprinodon* spp.
Salmon, Chinook	*Oncorhynchus tshawytscha*
Salmon, Chum	*Oncorhynchus keta*
Salmon, Coho	*Oncorhynchus kitsch*
Salmon, Pink	*Oncorhynchus gorbusca*
Shiner, Red	*Cyprinella lutrensis*
Stickleback, Unarmored Threespine	*Gasterosteus aculeatus wiliamsoni*
Sturgeon, Pallid	*Scaphirhynchus albus*
Sucker, Razorback	*Xyrauchen texanus*
Sunfish	*Lepomis* spp.
Sunfish, Bluegill	*Lepomis macrochirus*
Sunfish, Green	*Lepomis cyanellus*
Trout, Apache	*Oncorhynchus apache*
Trout, Brook	*Salvelinus fontinalis*
Trout, Brown	*Salmo trutta*
Trout, Bull	*Salvelinus confluentus*
Trout, Cutthroat	*Oncorhynchus clarki clarki*
Trout, Cutthroat Bonneville	*Oncorhynchus clarki utah*
Trout, Cutthroat Lahontan	*Oncorhynchus clarki henshawi*
Trout, Gila	*Oncorhynchus gilae*
Trout, Lake	*Salvelinus namaycush*
Trout, Rainbow (Steelhead)	*Oncorhynchus mykiss*
Walleye	*Stizostedion vitreum*
AMPHIBIANS and REPTILES	
Bullfrog	*Rana catesbeiana*

Common Name	Scientific Name
AMPHIBIANS and REPTILES (Cont.)	
Chuckwalla	*Sauromalus ater*
Ensatina	*Ensatina eschscholtzii*
Frog, Wood	*Rana sylvatica*
Frog, Columbia Spotted	*Rana luteiventris*
Iguana, Desert	*Dipsosaurus dorsalis*
Lizard, Alligator	*Elgaria multicarinata multicarinata*
Lizard, Sagebrush	*Sceloporus graciosus*
Lizard, Yucca Night	*Xantusia vigilis vigilis*
Rattlesnake, Western	*Crotalus viridis*
Salamander, Clouded	*Aneides ferreus*
Salamander, Mount Lyell	*Hydromantes platycephalus*
Salamander, Olympic	*Rhyacotriton olympicus*
Salamander, Oregon Slender	*Batrachoseps wrighti*
Salamander, Pacific Giant	*Dicamptodon tenebrosus*
Salamander, Relictual Slender	*Batrachoseps relictus*
Salamander, Western Red-back	*Plethodon vehiculum*
Snake, Common Garter	*Taricha sirtalis*
Snake, Northwestern Garter	*Thamnophis ordinoides*
Toad, Spadefoot	*Scaphiopus* spp.
Turtle, Desert	*Gopherus agassizi*
Turtle, Painted	*Chrysemys picta*
Turtle, Western Pond	*Clemmys marmorata*
BIRDS	
Bobolink	*Dolichonyx oryzivorus*
Bobwhite, Masked	*Colinus virginianus*
Bushtit, Common	*Psaltriparus minimus*
Chickadee	*Poecile atricapillus*
Chicken, Lesser Prairie	*Tympanuchus pallidicintus*
Crossbill, White-winged	*Loxia leucoptera*
Crow, American	*Corvus brachyrhynchos*
Dove, Mourning	*Zenaida macroura*
Eagle, Bald	*Haliaeetus leucocephalus*
Eagle, Golden	*Aquila chrysaetos*
Eider, Spectacled	*Somateria fischeri*
Eider, Stellar's	*Polysticta stelleri*
Falcon, Peregrine	*Falco peregrinus*
Flicker, Gilded	*Colaptes chrysoides*
Flycatcher, Southwestern Willow	*Epidomax tralli extimus*
Grouse, Columbian Sharp-tailed	*Tympanuchus phasianellus columbianus*
Grouse, Greater Sage	*Certracercus urophasianus phaios*
Grouse, Ruffed	*Bonasa umbellus*
Grouse, Sage	*Centrocercus urophosianus*
Grouse, Sharp-tailed	*Tympanuchus phasianellus*
Grouse, Spruce	*Falcipennis canadensis*
Gyrfalcon	*Falco rusticolus*
Hawk, Ferruginous	*Bureo regalis*
Hawk, Rough-legged	*Buteo lagopus*
Hummingbird	Trochilidae
Jay, Pinyon	*Gymnorhinus cyanocephalus*
Jay, Steller's	*Cyanocitta stelleri*

Common Name	Scientific Name
BIRDS (Cont.)	
Junco, Dark-eyed	*Junco hyemalis*
Kinglet	*Regulus* spp.
Lark, Horned	*Eremophila alpestris*
Mockingbird	*Mimus pollyglatos*
Murrelet, Marbled	*Brachyramphus marmoratus*
Nuthatch	*Sitta* spp.
Nuthatch, White-breasted	*Sitta carolinensis*
Owl, Burrowing	*Athene cunicularia*
Owl, Elf	*Micrathene Whitneyi*
Owl, Snowy	*Nyctea scandiaca*
Owl, Spotted	*Strix occidentalis*
Pigeon, Rock	*Columba livia*
Plover, Mountain	*Eupoda montana*
Plover, Western Snowy	*Charadrius alexandrinus*
Ptarmigan	*Lagopus lagopus*
Quail, Mountain	*Oreortyx pictus*
Quail, Northern Bobwhite	*Colinus virginianus*
Rail, Clapper	*Rallus longirostris*
Raven, Common	*Corvus corax*
Robin, American	*Turdus americanus*
Sparrow, Black-throated	*Amphispiza bilineata*
Sparrow, Brewer's	*Spizella breweri*
Sparrow, House (English)	*Passer domesticus*
Sparrow, Sage	*Amphispiza belli*
Sparrow, Savannah	*Passerculus sandwichensis*
Sparrow, Vespers	*Pooecetes gramineus*
Starling, European	*Sturnus vulgaris*
Swift, Vaux's	*Chaetura vauxi*
Thrasher, California	*Toxostoma redivivum*
Titmouse, Plain	*Parus inornatus*
Towhee, Eastern	*Pipilo erythrophthalmus*
Turkey, Wild	*Meleagris gallopavo*
Woodpecker, Acorn	*Melanerpes formicivorus*
Woodpecker, Gila	*Melanerpes uropygialis*
Woodpecker, Golden-fronted	*Melanerpes aurifrons*
Woodpecker, Lewis'	*Melanerpes lewis*
Woodpecker, White-headed	*Picoides albolarvatus*
Wren, Cactus	*Campylorhynchus brunneicapillus*
Wren, Winter	*Troglodytes troglodytes*
Wrentit	*Chamaea fasciata*
MAMMALS	
Antelope, Pronghorn	*Antilocapra americana*
Badger	*Taxidea taxus*
Bat, Lesser Long-nosed	*Leptonycteris curosoae yerbuensis*
Bat, Mexican Long-nosed	*Leptonycteris nivalis*
Bear, Black	*Ursus americanus*
Bear, Grizzly (Brown)	*Ursus arctos*
Bear, Polar	*Ursus maritimus*
Beaver	*Castor canadensis*
Bison	*Bison bison*

Common Name	Scientific Name
MAMMALS (Cont.)	
Bobcat	*Felis rufus*
Caribou	*Rangifer tarandus*
Chipmunks, Least	*Eutamias minimus*
Coati-mundi	*Nasua narica*
Cottontail	*Sylvilagus* spp.
Cottontail, Desert	*Sylvilagus auduboni*
Cougar	*Puma concolor*
Coyote	*Canis latrans*
Deer	*Odeocoileus* spp.
Deer, Black-tailed	*Odeocoileus hemionus*
Deer, Mule	*Odeocoileus hemionus*
Deer, White-tailed	*Odeocoileus virginianus*
Elk	*Cervus elaphus*
Ferret, Black-footed	*Mustela nigripes*
Fox, Arctic	*Alopex lagopus*
Fox, Gray	*Urocyon cinereoargenteus*
Fox, Kit	*Vulpes macrotis*
Fox, Red	*Vulpes vulpes*
Fox, Swift	*Vulpes velox*
Gopher, Northern Pocket	*Thomomys talpoides*
Gopher, Pocket	*Thomomys* spp.
Jackrabbit	*Lepus* spp.
Jackrabbit, Black-tailed	*Lepus californicus*
Jaguar	*Panthera onca*
Lemming, Brown	*Lemmus trimucronatus*
Marmot, Hoary	*Marmota caligata*
Marten	*Martes americana*
Moose	*Alces alces*
Mountain Lion	*Puma concolor*
Mouse, California	*Peromyscus californicus*
Mouse, Deer	*Peromyscus maniculatus*
Mouse, Pinyon	*Peromyscus truei*
Muskox	*Ovibos moschatus*
Peccary, Collared	*Tayassu tajacu*
Prairie Dog	*Cynomys* spp.
Prairie Dog, Black-tailed	*Cynomys ludovicianus*
Prairie Dog, White-tailed	*Cynomys gunnisoni*
Rabbit, Brush	*Sylvilagus bachmani*
Rbbit, Pygmy	*Brachylagus idahoensis*
Rat, Kangaroo	*Dipodomys deserti*
Rat, Norway	*Rattus norvegicus*
Sheep, Bighorn	*Ovis canadensis*
Sheep, Desert Bighorn	*Ovis canadensis nelsoni*
Skunk, Striped	*Mephitis mephitis*
Squirrel, Albert	*Sciurus alberti*
Squirrel, Arctic Ground	*Spermophilus parryii*
Squirrel, Flying	*Glaucomys volans*
Squirrel, Idaho Ground	*Spermophilus brunneus*
Squirrel, Mexican Ground	*Spermophilus mexicanus*
Squirrel, Northern Idaho Ground	*Spermophilus brunneus*

Common Name	Scientific Name
MAMMALS (Cont.)	
Squirrel, Washington's Ground	*Spermophilus washingtoni*
Squirrel, Western Gray	*Sciurus griseus*
Vole, Mountain	*Microtus montanus*
Weasel	*Mustela* spp.
Wolf, Gray	*Canis lupus*
Wolverine	*Gulo gulo*
Woodchuck	*Marmota monax*
Woodrat	*Neotoma* spp.

APPENDIX B

HUMAN HEALTH RISK ASSESSMENT

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

AC	-	Concentration of active ingredient in concentrate
acute PAD	-	Acute population adjusted dose
AGDISP	-	Agricultural dispersal model
a.i.	-	Active ingredient
ALS	-	Acetolactate-synthase
ANS	-	Accession number system
AR	-	Application rate
ARI	-	Aggregate risk index
AT	-	Acres treated
ATV	-	All-terrain vehicle
BCF	-	Bioconcentration factor
BLM	-	Bureau of Land Management
BR	-	Berry residue
BW	-	Body weight
C	-	Concentration
CalEPA	-	California Environmental Protection Agency
CAS	-	Chemical Abstracts Service
CBI	-	Confidential business information
CF	-	Conversion factor
chronic PAD	-	Chronic population adjusted dose
CREAMS	-	Chemical runoff erosion assessment management system
CRP	-	Conservation Reserve Program
CSF	-	Cancer slope factor
DAF	-	Dermal absorption factor
DFR	-	Dislodgeable foliar residue
DR	-	Deposition rate
EF	-	Exposure factor
EFH	-	Exposure Factors Handbook
EIS	-	Environmental Impact Statement
EPC	-	Exposure point concentration
ERA	-	Ecological risk assessment
ET	-	Exposure time
F	-	Fraction
FQPA	-	Food Quality Protection Act
GLEAMS	-	Groundwater Loading Effects of Agricultural Management Systems
HDT	-	Highest dose tested
HED	-	Health Effects Division
HHRA	-	Human health risk assessment
HSDB	-	Hazardous Substances Data Bank
IAF	-	Inhalation absorption factor
IR	-	Ingestion rate
IRIS	-	Integrated Risk Information System
Kp	-	Dermal permeability constant
lb	-	Pound(s)
LC_{50}	-	Median lethal concentration
LD_{50}	-	Median lethal dose
LDT	-	Lowest dose tested
LOAEL	-	Lowest observed adverse effect level
mg/kg	-	Milligrams per kilogram
mg/kg-day	-	Milligrams per kilogram of body weight per day
mg/L	-	Milligrams per liter

LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS (Cont.)

MA DEM/MA DEP	-	Massachusetts Department of Environmental Management/Massachusetts Department of Environmental Protection
MOE	-	Margin of exposure
MRID	-	Master Record Identification
NAS	-	National Academy of Sciences
NASA	-	National Aeronautics and Space Administration
NMF	-	N-Methyl formamide
NOAEL	-	No observed adverse effect level
NYSDOH	-	New York State Department of Health
OEHHA	-	Office of Environmental Health Hazard Assessment
OPP	-	Office of Pesticide Programs
PAD	-	Population adjusted dose
PEIS	-	Programmatic Environmental Impact Statement
PHED	-	Pesticide Handlers Exposure Database
PMP	-	Project management plan
PPE	-	Personal protective equipment
ppm	-	parts per million
RED	-	Reregistration Eligibility Decision
RfD	-	Reference dose
ROW	-	Rights-of-way
S	-	Spill amount
SA	-	Surface area
SAR	-	Surface area ratio
SDTF	-	Spray Drift Task Force
SERA	-	Syracuse Environmental Research Associates, Inc.
SF	-	Safety factor
SOP	-	Standard operating procedure
Tc	-	Transfer coefficient
UE	-	Unit of exposure
UF	-	Uncertainty factor
USEPA	-	United States Environmental Protection Agency
USDA	-	United States Department of Agriculture
USDI	-	United States Department of the Interior
USLE	-	Universal Soil Loss Equation

APPENDIX B

HUMAN HEALTH RISK ASSESSMENT

Introduction

As part of the Programmatic Environmental Impact Statement (PEIS), a Human Health Risk Assessment (HHRA) was conducted to evaluate potential human health and environmental risks that may result from herbicide exposure both during and after treatment of public lands (ENSR 2004a). This HHRA appendix summarizes the results of that assessment.

Previous EISs prepared by United States Department of the Interior Bureau of Land Management (USDI BLM) addressed the use of 20 herbicides, hereafter referred to as the "currently-available" herbicides (see Table 2-2 in PEIS). Under the current PEIS, this HHRA evaluates the following six herbicides, most of which are not available for use on public lands, and are hereafter called the "new" herbicides:

- Dicamba (active ingredient [a.i.] along with diflufenzopyr in Overdrive®; manufactured by BASF)
- Diflufenzopyr (a.i. along with dicamba in Overdrive®; manufactured by BASF)
- Diquat (a.i. in Reward®; manufactured by Syngenta)
- Fluridone (a.i. in Sonar®A.S.; manufactured by SePRO)
- Imazapic (a.i. in Plateau®; manufactured by BASF)
- Sulfometuron methyl (a.i. in Oust®; manufactured by DuPont)

Note that in the HHRA, Overdrive® was evaluated as its two separate components, dicamba and diflufenzopyr, as these two have different toxicological endpoints, indicating that their effects on human health are not additive.

Oust® is the only herbicide from the previous EISs that is reevaluated in this HHRA. Oust® has been found to impact non-target vegetation when carried on soil to untreated areas, and these effects were not evaluated in the earlier vegetation treatment EISs. Thus, the effects of Oust on target and non-target vegetation are analyzed in this HHRA.

The "currently-available" herbicides are not evaluated in this HHRA because the human health effects of these herbicides were adequately addressed in the previous EISs (USDI BLM 1991, U.S. Department of Agriculture [USDA] Forest Service 2004). A discussion of how the "currently available" herbicide risk estimates calculated under earlier EISs might change if they were evaluated using updated risk assessment methods and toxicity values begins on page B-82.

Human Health Risk Assessment Overview

The risk assessments included in the four previous EISs followed HHRA guidelines as developed by the National Academy of Sciences (NAS 1983). Since then, both the U.S. Environmental Protection Agency (USEPA) Superfund program (USEPA 1989) and the USEPA Office of Pesticide Programs (OPP; USEPA 2000a) have developed new guidelines for HHRAs. While the original scope of work for development of the HHRA stated that the template for the report, exposure scenarios, and evaluation would be obtained from the previous EISs, the BLM convened an inter-agency work group consisting of representatives from the BLM and USEPA from May through October of 2002 to review these methods and compare them with current risk assessment practice. The ultimate goal of these discussions was to reach consensus on updated risk assessment methods to ensure that the risk assessment methodology employed in the current PEIS is scientifically defensible, is consistent with currently available guidance where appropriate, and meets the needs of the BLM vegetation treatment program.

The HHRA complies with USEPA guidance for conducting risk assessments for pesticides including, but not limited to, the following documents:

- *The Role of Use-Related Information in Pesticide Risk Assessment and Risk Management* (USEPA 2000a)

- *Guidance for Performing Aggregate Exposure and Risk Assessments* (USEPA 1999a)
- *Exposure Factors Handbook* (USEPA 1997a)

Organization of Document

The HHRA follows the four-step paradigm as identified by NAS (1983). The steps are:

- Hazard identification
- Dose-response assessment
- Exposure assessment
- Risk characterization

Each of these steps is discussed in the following sections.

Hazard Identification

The purpose of the hazard identification process is to identify and summarize toxicity information for the six new herbicides that are quantitatively evaluated in the HHRA.

Chemical Characteristics and Usage

This section provides simple chemical descriptions and usage summaries for the six new herbicides. The BLM and the HHRA project team have compiled application type and rate information specific to BLM practices for each of the six herbicides.

Dicamba

Dicamba is the a.i. along with diflufenzopyr in Overdrive®. This herbicide is manufactured by BASF. According to the manufacturer's label, dicamba is a selective postemergence herbicide for the management of annual broadleaf weeds and/or suppression of perennial broadleaf weeds. Activity is also noted for suppression of annual grassy weeds. As a dry, flowable herbicide formulation, a combination of dicamba and diflufenzopyr is mixed with water and is presently registered for use on corn, rangeland, pasture, and non-cropland situations. Dicamba kills broadleaf weeds before and after they sprout. Overdrive® is a selective systematic herbicide for the control of broadleaf weeds pre- or post-emergence. Overdrive® disrupts plant hormone balance and protein synthesis. Overdrive® is provided as a wettable granular formulation.

Diflufenzopyr

Diflufenzopyr is the a.i. along with dicamba in Overdrive®. This herbicide is manufactured by BASF. According to the manufacturer's label, diflufenzopyr is formulated with dicamba, and the herbicide is a selective post-emergence herbicide for the management of annual broadleaf weeds and/or the suppression of perennial broadleaf weeds. Activity is also noted for suppression of annual grassy weeds. Diflufenzopyr acts by inhibiting auxin transport. As a dry, flowable herbicide formulation, a combination of diflufenzopyr and dicamba is mixed with water and is presently registered for use on corn, rangeland, pasture, and non-cropland situations.

Diquat

Diquat is the a.i. in Reward®. This herbicide is manufactured by Syngenta (2002). According to the manufacturer's label, Reward Landscape and Aquatic Herbicide is a nonvolatile chemical for use as a general herbicide to control weeds in non-crop and aquatic areas. This herbicide controls weeds by interfering with photosynthesis within green plant tissue. In the BLM vegetation treatment program, Reward® will only be used in aquatic areas.

Fluridone

Fluridone is the a.i. in Sonar® A.S. This herbicide is manufactured by SePRO. According to the manufacturer's label, Sonar® A.S. herbicide is a selective systemic aquatic herbicide for management of aquatic vegetation in fresh water ponds, lakes, reservoirs, drainage canals, and irrigation canals. Sonar® A.S. is absorbed from water by plant shoots and from hydrosoil by the roots of aquatic vascular plants. It is important to maintain the recommended concentration of Sonar® A.S. in contact with the target plants for a minimum of 45 days. In susceptible plants, Sonar® A.S. inhibits the formation of carotene. In the BLM vegetation treatment program, Sonar® A.S. will only be used in aquatic areas.

Imazapic

Imazapic is the a.i. in Plateau®. This herbicide is manufactured by BASF. According to the manufacturer's label, Plateau® herbicide is an aqueous solution to be mixed with water and applied as a spray solution to provide weed control and/or turf height suppression on pastures, rangeland, federal Conservation Reserve Program (CRP) land and non-

cropland areas including non-cropland areas that may be grazed or cut for hay. For post-emergence applications, a surfactant is added to the mixture to increase adherence of the herbicide to plant leaves. Plateau® herbicide is readily absorbed through leaves, stems, and roots, and is translocated rapidly throughout the plant, with accumulation in the meristematic regions. Imazapic is an acetolactate-synthase (ALS) inhibitor, a potent herbicide that acts by inhibiting an enzyme needed for essential amino acid synthesis.

Sulfometuron Methyl

Sulfometuron methyl is the a.i. in Oust®. This herbicide is manufactured by DuPont. According to the manufacturer's label, Oust® herbicide is a dispersible granule that is mixed in water and applied as a spray. Oust® controls many annual and perennial grasses and broadleaf weeds in forestry and non-crop sites. Oust® may be used for general weed control on industrial non-crop sites and for selective weed control in certain types of unimproved turf grasses on industrial sites. It can also be used for selective weed control in forest site preparation and in the release of several types of pines and certain hardwoods. Oust® controls weeds by both pre-emergence and post-emergence activity. Sulfometuron methyl is also ALS inhibitor.

Toxicity Profiles

This section includes toxicity profiles for each of the herbicides that summarize the potential toxicity of each herbicide and provide information that puts the toxicity into context. The toxicity profiles include information on acute, subchronic, and chronic toxicity studies, reproductive and developmental toxicity studies, cancer bioassays, mutagenicity studies, epidemiology studies, metabolism, and toxicokinetics.

General Information

Much of the toxicity information discussed in this section is from USEPA reports, such as the Pesticide Fact Sheets or HHRAs conducted by the OPP Health Effects Division (HED) to evaluate use of the pesticides on specific crops. In addition, a literature search was conducted to ensure that relevant available information was used in these toxicity profiles. The databases searched include the National Library of Medicine's Hazardous Substances Data Bank (HSDB) and Toxline. The USEPA receives many unpublished toxicity data sets that are referenced in USEPA documents using Master Record Identification (MRID) numbers. This is the USEPA's system of recording and tracking studies submitted to the USEPA and replaces the earlier Accession Number System (ANS). In this HHRA, the MRID or Accession numbers are noted where provided along with the USEPA document in which they are referenced. Due to the confidential business information (CBI) status of much of the MRID-referenced information, the USEPA reports are generally the primary reference for this review.

Each of the toxicity profiles includes information on acute toxicity. As shown in Table B-1, the USEPA has developed toxicity categories for pesticides based on acute toxicity animal tests conducted in support of registration of the pesticides (USEPA 2003f). Acute toxicity studies are used to determine a number of toxicity endpoints based on a single dose or several large doses of a substance. An important endpoint in acute testing is the toxicity reference level known as the median lethal dose (LD_{50}), which is the dose, usually administered orally, that kills 50 percent of the test animals. The lower the LD_{50}, the greater the toxicity of the chemical. In addition to the acute oral LD_{50}, the USEPA has a battery of laboratory toxicity studies considered as acute tests (USEPA 2003f) that include acute dermal, acute inhalation (rat), eye irritation (rabbit), dermal irritation (rabbit), and dermal sensitization (guinea pig tests; Table B-1). For the different toxicity endpoints, the USEPA defines four toxicity categories (I through IV), with higher toxicity categories representing lower herbicide acute toxicity.

In longer-term toxicity studies (chronic or subchronic) the endpoints for evaluation are the No Observed Adverse Effect Level (NOAEL) and the lowest dose at which an adverse effect has been observed, called a Lowest Observed Adverse Effect Level (LOAEL). Where both levels can be identified in a single study, for a given effect, the LOAEL will always be higher than the NOAEL. In some studies, adverse effects are observed at all dose levels; in these cases, the lowest dose tested (LDT) is identified as the LOAEL. By contrast, where no adverse effects are seen at any dose level tested, the highest dose tested (HDT; also referred to as the limit dose) is identified as the NOAEL.

Dicamba

Dicamba is a benzoic acid herbicide a.i.. It can be applied to the leaves or to the soil. Dicamba controls annual and perennial broadleaf weeds in grain crops and grasslands, and it is used to control brush and bracken in pastures. It kills broadleaf weeds before and after they sprout. In combination with a phenoxyalkanoic acid or other herbicide, dicamba is used in pastures, rangeland,

and non-crop areas such as fencerows and roadways to control weeds. The USEPA has classified this herbicide a.i. as toxicity class III – slightly toxic. Products containing dicamba bear the Signal Word WARNING (Extension Toxicology Network [Extoxnet] 1996c).

Acute Toxicity

Table B-2 lists the toxicity categories for dicamba. In tests in rats, the acute oral LD_{50} was 2,740 milligrams per kilogram (mg/kg), placing it in Toxicity Category III. The acute dermal toxicity study in rats showed an LD_{50} greater than 2,000 mg/kg, placing it in Toxicity Category III. The acute inhalation toxicity study in rats showed a median lethal concentration (LC_{50}) greater than 5.3 milligrams per Liter (mg/L), placing it in Toxicity Category IV. The primary eye irritation study in rabbits places dicamba in Toxicity Category II. The primary dermal irritation study categorized dicamba as an irritant, placing it in Toxicity Category II. The primary dermal sensitization study in guinea pigs did not exhibit any sensitization potential (USEPA 2001h).

Subchronic Toxicity

In a subchronic neurotoxicity study, Sprague-Dawley rats (10/sex/dose) were fed diets containing dicamba at 0, 3,000, 6,000, or 12,000 parts-per-million (ppm; 0, 197.1, 401.4, 767.9 milligrams per kilogram of body weight per day (mg/kg-day) for males and 0, 253.4, 472.0, or 1028.9 mg/kg-day for females, respectively) for 13 weeks. Neurobehavioral evaluations, consisting of locomotor activity, and auditory startle response, were conducted at prestudy and during weeks 4, 8, and 13. No toxicologically significant differences were noted in either the mean body weights (BWs) or food consumption of the treated animals. Neurobehavioral evaluations at the 4-, 8-, and 13-week evaluations revealed rigid body tone, slightly impaired righting reflex and impaired gait. At week 13, the incidences of these findings were decreased. Rigid body tone was also noted during evaluation of the righting reflex and land foot splay. The NOAEL was 401 mg/kg-day and the LOAEL was 768 mg/kg-day based on rigid body tone, slightly impaired righting reflex and impaired gait (MRID No. 43245210; USEPA 2001h).

Chronic Toxicity/Carcinogenicity

In a combined chronic toxicity and carcinogenicity study in rats, dietary administration of dicamba at 0, 50, 250 or 2500 ppm (0, 2.5, 12.5 or 125 mg/kg-day, respectively) for 117 weeks resulted in a dose-related increase in ventricular dilation of the brain in female rats with the incidences at the high dose reaching statistical significance. The incidences were 15/49 (31%), 18/49 (37%), 20/50 (40%) and 30/49 (61%) at 0, 2.5, 12.5, or 125 mg/kg-day, respectively. There was no increased incidence of tumors at any of the doses, suggesting that dicamba is not carcinogenic (MRID No. 000258115; USEPA 2001h).

Developmental Toxicity

In a developmental toxicity study, pregnant CD Charles River rats (25/dose group) received gavage administration of dicamba in corn oil at dose levels of 0, 64, 160, or 400 mg/kg-day during gestation days 6 through 19. Maternal toxicity, limited to the high dose (400 mg/kg-day), was characterized by mortality in 4 pregnant females that exhibited neurotoxic signs prior to death: clinical signs of nervous system toxicity that included ataxia, salivation, stiffening of the body when held, and decreased motor activity; statistically significant decreases in BW gain during the dosing period; and decreases in food consumption. For maternal toxicity, the NOAEL was 160 mg/kg-day and the LOAEL was 400 mg/kg-day based on mortality, clinical signs, BW changes and decreases in food consumption. No treatment-related fetal anomalies were seen at any dose level. For developmental toxicity, the NOAEL was greater than 400 mg/kg-day; a LOAEL was not established (MRID No. 00084024; USEPA 2001h).

In a development toxicity study, inseminated New Zealand White rabbits (19 to 20/dose) were given oral capsules containing dicamba at dose levels of 0, 30, 150, or 300 mg/kg-day from days 6 through 18 of gestation. No maternal toxicity was observed at 30 mg/kg-day. At 150 mg/kg-day, maternal toxicity was characterized by abortion (5%) and clinical signs such as ataxia, and decreased motor activity. At 300 mg/kg-day, maternal toxicity was manifested by abortions, clinical signs, decreased BW and decreased food consumption. For maternal toxicity, the NOAEL was 30 mg/kg-day and the LOAEL was 150 mg/kg-day based on abortions and neurotoxic clinical signs. Development toxicity at 300 mg/kg-day was manifested by irregular ossification of the nasal bones of the skull; no developmental toxicity was seen at 30 or 150 mg/kg-day. For developmental toxicity, the NOAEL was 150 mg/kg-day and the LOAEL was 300 mg/kg-day based on irregular ossification of internasal bones (MRID No. 42429401; USEPA 2001h).

TABLE B-1
Acute Toxicity Categories and Definitions

Toxicity Category	I	II	III	IV
Oral LD_{50}	0 to 50 mg/kg	50 to 500 mg/kg	500 to 5,000 mg/kg	> 5,000 mg/kg
Inhalation LC_{50}[1]	0 to 0.2 mg/L	0.2 to 2 mg/L	2 to 20 mg/L	> 20 mg/L
Dermal LD_{50}	0 to 200 mg/kg	200 to 2,000 mg/kg	2,000 to 20,000 mg/kg	> 20,000 mg/kg
Eye effects	Corrosive, corneal opacity not reversible within 7 days	Corneal opacity reversible within 7 days; irritation persisting for 7 days	No corneal opacity; irritation reversible within 7 days	No irritation
Skin effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation at 72 hours

[1] LC_{50} = median lethal concentration.
mg/kg = milligrams of chemical per kilogram of body weight.
mg/L = milligrams of chemical per liter of air.
Source: USEPA 2003f.

TABLE B-2
Toxicity Categories for Short-term Tests

Herbicide	Acute Oral[1]	Acute Dermal[1]	Acute Inhalation[1]	Primary Eye[2]	Primary Skin[2]	Dermal Sensitizer	Reference
Dicamba	III	III	IV	II	II	No	USEPA 2001h
Diflufenzopyr	IV	IV	IV	III	IV	No	USEPA 2001c
Diquat	III	II	III	II	IV	No	USEPA 2001e
Fluridone	IV	III	III	II	IV	No	USEPA 1986a, 1988
Imazapic	IV	III	IV	III	IV	No	USEPA 2001a
Sulfometuron methyl	NA	NA	NA	NA	NA	NA	(see text)

NA = Not Available from USEPA.

[1] USEPA labeling guidelines acute, oral, dermal, and inhalation effects:
I. Severe; oral LD_{50} 0-50 mg/kg, dermal LD_{50} 0-200 mg/kg, inhalation LC_{50} 0-0.2 mg/L.
II. Moderate; oral LD_{50} 50-500 mg/kg, dermal LD_{50} 200-2000 mg/kg, inhalation LC_{50} 0.2-2 mg/L.
III. Slight; oral LD_{50} 500-5,000 mg/kg, dermal LD_{50} 2,000-20,000 mg/kg, inhalation LC_{50} 2-20 mg/L.
IV. Very slight; oral LD_{50} >5,000 mg/kg, dermal LD_{50} >20,000 mg/kg, inhalation LC_{50} >20 mg/L.

[2] USEPA labeling guidelines for pesticides applied to skin or eyes:
I. Irreversible corneal opacity at 7 days; corrosive to skin.
II. Corneal opacity reversible within 7 days; severe skin irritation at 72 hours.
III. No corneal opacity; moderate skin irritation at 72 hours.
IV. No irritation to the eyes; mild or slight skin irritation at 72 hours.

Reproductive Toxicity

In a two-generation reproduction study, Sprague-Dawley rats (32 or 28/group) received dicamba in the diet at dose levels of 0, 500, 1500, or 5,000 ppm (0, 40, 122, or 419 mg/kg-day for males and 0, 45, 136, or 450 mg/kg-day for females, respectively) for two generations. Systemic toxicity was observed at 5,000 ppm, manifested as clinical signs in pregnant females from both generations during lactation (stiff body tone and slow righting reflex) and significantly increased relative liver to BWs in both generations and sexes, adults as well as weanlings. For parental systemic toxicity, the NOAEL was 122 and 136 mg/kg-day for males and females, respectively; and the LOAEL was 419 and 450 mg/kg-day in males and females based on clinical signs of neurotoxicity. Reproductive toxicity at 1,500 and 5,000 ppm, manifested as significantly decreased pup growth in all generations and matings at 1,500 ppm and at 5,000 ppm. In addition, delayed sexual maturation was noted in first generation males at 5,000 ppm. For offspring toxicity, the NOAEL was 45 mg/kg-day and the LOAEL was 136 mg/kg-day based on significantly decreased pup growth (MRID No. 43137101) (USEPA 2001h).

Neurotoxicity

In an acute neurotoxicity study, groups of Crl:CD BR rats (10/sex/dose) received a single oral administration of dicamba in corn oil at doses of 0, 300, 600, or 1,200 mg/kg. At 300 mg/kg, transiently impaired respiration; rigidity upon handling, prodding or dropping; freezing of movement when touched; decreased arousal and fewer rears/minute compared to controls; and impairment of gait and righting reflex were observed in both sexes. In addition, males showed decreased forelimb grip strength. With the exception of the decrease in forelimb grip strength, which persisted until day 7, these effects were observed only on the day of dosing. In addition, at 600 mg/kg, both sexes showed decreases in locomotor activity and males showed significant decreases in tail flick reflex and a raised posture when placed in an open field. At the highest dose level tested (1,200 mg/kg), both males and females showed an impaired startle response to an auditory stimulus. In addition, males showed decreases in BW, BW gain and food consumption. The LOAEL was 300 mg/kg based on the several neurologic signs listed above; a NOAEL was not established (MRID No. 42774104; USEPA 2001h).

Mutagenicity

Dicamba was negative in tests for mutagenicity (Extoxnet 1996c).

Metabolism

Dicamba was excreted rapidly by rats, mainly in the urine, when administered orally or subcutaneously; 1 to 4% was excreted in the feces. Mice, rats, rabbits and dogs excreted 85% of an oral dose as unmetabolized dicamba in the urine within 48 hours of dosing. Eventually, between 90% and 99% of the dose was excreted unmetabolized in the urine. This indicates that dicamba is rapidly absorbed into the bloodstream from the gastrointestinal tract. When dicamba was ingested daily in the feed, the concentrations in different organs reached a steady state within 2 weeks. When daily intake stopped, storage in the organs declined rapidly. Therefore, dicamba does not bioaccumulate in mammalian tissues (Extoxnet 1996c).

Diflufenzopyr

Diflufenzopyr is the first a.i. from a chemical class called semicarbazones. It is registered for use on field corn and grass (USEPA 1999b). In plants, diflufenzopyr acts by inhibiting auxin transport, which causes an abnormal accumulation of auxins in meristematic shoot and root regions, disrupting the delicate auxin balance needed for plant growth (BASF 2001a). The USEPA has completed its review of product chemistry, environmental fate, toxicology, ecological effects, and residue chemistry data, and their summary statement says, "Based on available data, diflufenzopyr has been determined to be of low toxicity to humans, birds, aquatic organisms, mammals and bees. Acute toxicology studies place technical-grade diflufenzopyr in Toxicity Category III (Table B-2). It is neither teratogenic nor carcinogenic. Additionally, the data indicate no significant risk to non-target organisms, and diflufenzopyr is not expected to pose a risk of groundwater contamination" (USEPA 1999b).

Acute Toxicity

Table B-2 lists the toxicity categories for technical diflufenzopyr. The term 'technical' refers to the commercial product that may contain trace impurities, as opposed to the pure chemical form. The acute oral toxicity study in rats showed an LD_{50} greater than 5,000 mg/kg in males and females, placing it in Toxicity Category IV. The acute dermal toxicity study in rabbits showed an LD_{50} greater than 5,000 mg/kg in males and

females, placing it in Toxicity Category IV. The acute inhalation toxicity study in rats showed an LC_{50} greater than 2.93 mg/L in males and females, which places it in Toxicity Category IV according to USEPA 1999b (although according to the table, it would be in Toxicity Category III). The primary eye irritation study in rabbits showed mild irritation resolved within 48 hours, placing it in Toxicity Category III. The primary dermal irritation study in rabbits showed no irritation, placing it in Toxicity Category IV. The primary dermal sensitization study in guinea pigs did not exhibit any sensitization potential (USEPA 1999b).

Subchronic Toxicity

In a subchronic study in rats, Wistar rats were fed test diets containing technical diflufenzopyr at dose levels of 0, 1,000, 5,000, 10,000 and 20,000 ppm for a period of 13 weeks. The NOAEL was identified as 5,000 ppm (equal to 352 milligrams per kilogram per day [mg/kg-day] for males, and 431 mg/kg-day for females) based on lower mean BW gain and decreased food efficiency in the 10,000 and 20,000 ppm groups for both sexes. Additional findings were decreased food intake and slight changes in blood chemistry (i.e., slight increases in cholesterol and alanine aminotransferase and slight decreases in chloride levels). Histopathological findings included an increased incidence of foamy macrophages in the lungs in the 10,000 and 20,000 ppm groups and testicular atrophy in the 20,000 ppm group. Following the 4-week recovery period, the only treatment-related effects that showed partial or no evidence of recovery were foamy macrophages in the lungs and testicular atrophy (USEPA 1999b).

In a subchronic study in mice, CD-1 mice were dosed with diflufenzopyr at 0, 350, 1,750, 3,500, or 7,000 ppm in the diet for 13 weeks. The NOAEL was determined to be the HDT of 7,000 ppm (1,225 mg/kg-day in males and 1,605 mg/kg-day in females), as no clear toxic effects were observed (USEPA 1999b).

In a subchronic study in dogs, diflufenzopyr was administered to beagle dogs in the diet at dose levels of 0, 1,500, 10,000, or 30,000 ppm for 13 weeks. The LOAEL for this study is 10,000 ppm (403 mg/kg-day in males and 424 mg/kg-day in females), based on the occurrence of erythroid hyperplasia in the bone marrow, extramedullary hemopoiesis in the liver, and hemosiderin deposits in Kupffer cells. The NOAEL is 1,500 ppm (58 mg/kg-day in males and 59 mg/kg-day in females; USEPA 1999b).

In a subchronic dermal toxicity study, technical diflufenzopyr was administered by dermal application to male and female New Zealand White rabbits at dose levels of 0, 100, 300, or 1,000 mg/kg per application. Duration of application was 6 hours a day, daily for 21 to 24 consecutive days. The NOAEL for systemic toxicity was determined to be 1,000 mg/kg-day, since there were no apparent signs of treatment-related systemic effects observed in male or female rabbits at any dose level tested. A NOAEL for dermal effects could not be determined since local dermal irritation was observed at all dose levels (there were no corresponding findings upon histopathological examination, indicating that the dermal effects were all local; USEPA 1999b).

Chronic Toxicity/Carcinogenicity

In a chronic toxicity study in dogs, diflufenzopyr was administered to beagle dogs in the diet at dose levels of 0, 750, 7,500 or 15,000 ppm for 52 weeks. The LOAEL for this study is 7,500 ppm (299 mg/kg-day for males and 301 mg/kg-day for females), based on erythroid hyperplasia in the bone marrow in bone sections, reticulocytosis, and increased hemosiderin deposits in the liver, kidneys, and spleen. The NOAEL is 750 ppm (26 mg/kg-day for males and 28 mg/kg-day for females; USEPA 1999b).

In a mouse carcinogenicity study, male and female CD-1 mice were fed test diets containing technical diflufenzopyr at dietary concentrations of 0, 700, 3,500, or 7,000 ppm for a period of 78 weeks. The NOAEL for systemic toxicity was determined to be 7,000 ppm (equal to 1,037 mg/kg-day for males and 1,004 mg/kg-day for females). There were no treatment-related effects observed at any dose level tested in male rats. There was a slight, but statistically significantly lower mean overall BW gain for females in the 7,000 ppm group, primarily due to decreased gain/increased weight loss during the second year of the study. In the absence of any other treatment-related findings, this result was not considered to be an adverse, toxicologically significant finding. There was no evidence of oncogenic potential of diflufenzopyr for male and female mice at any dose level tested (USEPA 1999b).

In a combined chronic toxicity/carcinogenicity study, male and female Wistar rats were fed test diets containing technical diflufenzopyr at dietary concentrations of 0, 500, 1,500, 5,000, or 10,000 ppm for a period of 104 weeks. The NOAEL for systemic toxicity was identified as 5,000 ppm (equal to 236 mg/kg-day for males and 323 mg/kg-day for females).

Treatment-related effects in the 10,000 ppm group were significantly lower BW and BW gains throughout the study period and decreased food efficiency. There was no evidence of oncogenic potential of diflufenzopyr at any dose level tested (USEPA 1999b).

Developmental Toxicity

In a developmental toxicity study, technical diflufenzopyr was administered by gavage to female Sprague Dawley rats at dose levels of 0, 100, 300, or 1,000 mg/kg-day from days 6 through 15 of gestation. The maternal NOAEL is 300 mg/kg-day and the maternal LOAEL is 1,000 mg/kg-day based on decreases in food consumption and weight gain. Developmental effects, characterized as significantly lower fetal BWs in males and skeletal variations, exhibited as incompletely ossified and unossified sternal centra and reduced fetal ossification sites for caudal vertebrae, were observed at 1,000 mg/kg-day. The developmental LOAEL is 1,000 mg/kg-day, based on decreased fetal BWs and skeletal variations. The developmental NOAEL is 300 mg/kg-day (USEPA 1999b).

In a developmental toxicity study, technical diflufenzopyr was administered by gavage to female New Zealand White rabbits at dose levels of 0, 30, 100, or 300 mg/kg-day from days 6 through 19 of gestation. The maternal LOAEL is 100 mg/kg-day, based on minimal reductions in BW gain with no reduction in food consumption and clinical signs of toxicity (abnormal feces). The maternal NOAEL is 30 mg/kg-day. Developmental effects, characterized as significant increases in the incidence of supernumerary thoracic rib pair ossification sites, occurred at the 300 mg/kg-day dose. No treatment-related developmental effects were noted at the low and mid doses. The developmental LOAEL is 300 mg/kg-day based on increased skeletal variations (supernumerary rib ossification sites). The developmental NOAEL is 100 mg/kg-day (USEPA 1999b).

Reproductive Toxicity

In a 2-generation reproduction study, technical diflufenzopyr was administered continuously in the diet to Wistar rats at dose levels of 0, 500, 2,000, or 8,000 ppm in the diet. The systemic LOAEL is 2,000 ppm based on reduced BW gain, increased food consumption, and increased seminal vesicle weights. The systemic NOAEL is 500 ppm. The reproductive LOAEL is 8,000 ppm based on lower live birth and viability indices, total pre-perinatal loss, reduced BWs and BW gain during lactation, a higher proportion of runts, and a higher percentage of offspring with no milk in the stomach. The reproductive NOAEL is 2,000 ppm (113 – 176 mg/kg-day; USEPA 1999b).

Neurotoxicity

In an acute neurotoxicity study, diflufenzopyr was administered by gavage to Crl:CD BR rats at dose levels of 0, 125, 500, or 2,000 mg/kg. Diflufenzopyr had no definite impact on neurotoxic responses, although a few abnormalities were observed in the functional battery on the day of dosing. A decrease in immediate righting responses that was observed in several males in all treatment groups was not concentration-dependent. Nasal staining was observed in more rats in the 2,000 mg/kg treatment groups (six males; three females), but was not considered a definite or significant response to treatment. Lower mean brain weights in all female treatment groups lacked associated macroscopic and microscopic histopathological changes, and were only 4 to 5% lower than the control brain weight. Mean locomotor activities for the 2,000 mg/kg female treatment groups were decreased on days 7 and 14 after dosing, but the pattern of activity for the individual animals was similar to the individual controls over time. There were no definite treatment-related differences in BWs or food consumption in any of the treatment groups. There was no evidence of treatment-related neuropathology in the 2,000 mg/kg treatment group. A LOAEL was not established. The NOAEL for acute neurotoxicity is 2,000 mg/kg (the limit dose; USEPA 1999b).

In a subchronic neurotoxicity study, diflufenzopyr was administered in the diet to Crl:CD BR rats at dose levels of 0, 25, 75, or 1,000 mg/kg-day for 13 weeks. No treatment-related neurotoxicological effects were observed at any treatment level. A LOAEL for neurotoxicological effects was not established; the NOAEL was 1,000 mg/kg-day for both sexes. Treatment-related toxic effects (other than neurotoxic effects) were observed at the 1,000 mg/kg-day treatment level. The toxicological LOAEL for this study is 1,000 mg/kg-day, based on decreased BW gains for both sexes. The toxicological NOAEL is 75 mg/kg-day (USEPA 1999b).

Mutagenicity

Diflufenzopyr tested negative for mutagenic potential in four assays: a microbial (*Salmonella typhimurium*) mutagenicity assay; an *in vitro* mammalian cell (mouse lymphoma) gene mutation assay; an *in vivo* mouse bone

marrow micronucleus assay; and an unscheduled DNA synthesis assay (USEPA 1999b).

Metabolism

In a rat metabolism study, radiolabeled diflufenzopyr was administered to Wistar rats as a single intravenous dose at 1 mg/kg-day, a single oral dose (gavage) at 10 or 1,000 mg/kg or a single dose at 10 mg/kg following a 14-day pretreatment with unlabeled diflufenzopyr at 10 mg/kg. Following oral administration, diflufenzopyr was partially absorbed and rapidly eliminated. By oral administration, 20 to 44% of the dose was eliminated in urine and 49 to 79% in feces. By contrast, intravenously dosed rats excreted 61 to 89% of the dose in urine. Biliary elimination accounted for 3 to 19% of the dose in all dose groups. Elimination half-life in urine and feces was 5.2 to 6.9 hours for all single dose groups and 7.7 to 10.8 hours for all repeat oral dose groups. Total radioactive residues in tissues from rats in all dose groups were less than 3% of the administered dose. Blood residue levels for all dose groups were less than 1% of the administered dose at all sampling intervals through 72 hours post-dose. Diflufenzopyr was eliminated in urine, feces, and bile primarily as unchanged parent compound (USEPA 1999b).

A metabolism study of diflufenzopyr was also conducted in laying hens and lactating goats. The data showed diflufenzopyr was rapidly eliminated from the animals. With a feeding level of 10 ppm in the diet, residue levels in edible tissues, milk, and eggs were less than 0.12 ppm. The metabolite profile in rat was similar in hen and goat (USEPA 1999b). These studies show that diflufenzopyr is rapidly eliminated as unchanged parent compound.

Diquat

Diquat dibromide is a non-selective contact herbicide, algicide, desiccant, and defoliant. As an herbicide/algicide, it is used to control broadleaf and grassy weeds in non-crop and aquatic areas. As a desiccant/defoliant, it is used in seed crops and potatoes (USEPA 1995). Diquat dibromide is rapidly absorbed into the leaves of plants, but usually kills the plant tissues necessary for translocation too quickly to allow movement to other parts of the plant. It does not kill roots, but it does kill the leaves and stems it contacts. It produces rapid results by interfering with photosynthesis. However, the sudden addition of decaying plant biomass to the water column can result in decreased oxygen levels (New York State Department of Environmental Conservation 1981; *cited in* McLaren/Hart 1995; Extoxnet 1996a).

Acute Toxicity

Table B-2 lists the toxicity categories for diquat dibromide. Diquat dibromide is not acutely toxic via the oral (Toxicity Category III) and inhalation (Toxicity Category III) routes of exposure. Diquat dibromide is moderately to severely toxic via the dermal route of exposure, as evidenced by the acute dermal toxicity study (Toxicity Category II). However, diquat dibromide was not found to be a dermal irritant (Toxicity Category IV) or a dermal sensitizer. Diquat dibromide is toxic to the eye, as evidenced by the eye irritation study, which showed slight to severe eye irritation following acute exposure (Toxicity Category II; USEPA 2001e).

Subchronic Toxicity

In a subchronic dermal toxicity study (MRID No. 40308101), Sprague-Dawley rats were exposed to technical diquat dibromide by dermal application at dose levels of 0, 5, 20, 40, or 80 mg/kg-day (as diquat cation). Duration of application was 6 hours a day, for 21 consecutive days. High mortality was observed in the 40 mg/kg (67%) and 80 mg/kg (90%) groups. Effects in the nonsurvivors included hypothermia, hypoactivity, dyspnea, cyanosis, pale extremities, and emaciated appearance. The LOAEL for systemic toxicity was determined to be 20 mg/kg-day, based on effects including sores, severe erythema, fissures, acute necrotizing purulent dermatitis, and degeneration of hair follicles and sebaceous glands, all at the application site. The NOAEL for systemic toxicity was 5 mg/kg-day, based on mortality and clinical signs at 20 mg/kg-day (LOAEL). Dermal irritation and tissue destruction occurred at the application site at all dose levels (USEPA 2001e).

In a subchronic inhalation toxicity study (MRID No. 40301701), Fischer 344 rats were exposed to respirable aerosols of technical diquat at concentrations of 0, 0.49, 1.1, or 3.8 microgram per liter (μg/L; as diquat cation). Exposure duration was 6 hours a day, 5 days per week for 21 days. Test animals, which were exposed whole body, and control animals were rinsed with tap water and blotted dry after each exposure to minimize oral exposure from grooming. Treatment-related effects observed at the lowest concentration tested included significant increases in mean lung weight, mottling and reddening of the lungs, and lung lesions. The NOAEL is 0.1 μg/L (males 0.024 mg/kg-day; females 0.026

mg/kg-day), based on increased lung weights and microscopic lesions in the lungs at the LOAEL of 0.49 µg/L (males 0.117 mg/kg-day, females 0.128 mg/kg-day (USEPA 2001e).

Chronic Toxicity/Carcinogenicity

In a chronic toxicity study in dogs (MRID No. 41730301), technical diquat dibromide was administered to beagle dogs in the diet at dose levels of 0, 0.5, 2.5, or 12.5 mg/kg-day (as diquat cation) for 52 weeks. No treatment-related effects were detected at any dose level in terms of survival, clinical signs, hematology, clinical chemistry, urinalysis, and gross pathology (except eye). Decreased BW gains were observed only during the first 2 weeks of dosing in both sexes at the high-dose level. At necropsy, bilateral lens opacity was observed in all high-dose males and three-fourths of the high-dose females. The NOAEL is 0.5 mg/kg-day, based on unilateral cataracts in females and decreased weight of the epididymides in males at the systemic LOAEL of 2.5 mg/kg-day (USEPA 2001e).

In a combined chronic toxicity/carcinogenicity study (MRID No. 00145855), male and female Sprague-Dawley rats were fed diets containing diquat cation at dietary concentrations of 0, 5, 15, 75, or 375 ppm for 104 weeks. Treatment-related effects observed in the 75 ppm group were lens opacity, marked or severe cataracts, and extralenticular lesions (adhesions, retinal detachment and synechia). Therefore, the systemic LOAEL is 75 ppm (equal to 2.91 mg/kg-day for males; 3.64 mg/kg-day for females) and the NOAEL for systemic toxicity was set at 15 ppm (equal to 0.58 mg/kg-day for males; 0.72 mg/kg-day for females). There was no treatment-related increase in tumor incidence in either sex (USEPA 2001e).

In a mouse carcinogenicity study (MRID No. 42219801), male and female CD-1 mice were fed diets containing technical diquat dibromide at dietary concentrations of 0, 30, 100, or 300 ppm (as diquat cation) for 104 weeks (2 years). Treatment-related effects observed in the 100 ppm group included eye discharge, decreased weight gain, increased kidney weight, tubular dilatation of the kidneys, tubular hyaline droplet formation in the kidneys, and lymphoid proliferation. Therefore the systemic LOAEL is 100 ppm (equal to 11.96 mg/kg-day for males; 16.03 mg/kg-day for females). The NOAEL for systemic toxicity was determined to be 30 ppm (equal to 3.56 mg/kg-day for males; 4.78 mg/kg-day for females). Diquat dibromide was not carcinogenic in male or female CD-1 mice (USEPA 2001e).

The database for carcinogenicity is considered complete. The carcinogenic potential of diquat dibromide was classified as Category E (evidence of noncarcinogenicity for humans) based on a lack of evidence of carcinogenicity in studies with two species, rat and mouse (USEPA 2001e).

Developmental Toxicity

In a developmental toxicity study (MRID No. 41198902), diquat dibromide was administered by gavage to female Wistar rats at dose levels of 0, 4, 12, or 40 mg/kg-day (as diquat cation) on days 7 through 16 of gestation. The LDT of 4 mg/kg-day was associated with decreased maternal weight gain and food consumption. The maternal LOAEL is <4 mg/kg-day and the NOAEL for maternal toxicity is not established. Developmental effects, characterized as significantly lower fetal BWs, increased incidence of a hemorrhagic kidney, and skeletal variations exhibited as incompletely ossified and unossified sternal centra and reduced fetal ossification sites for caudal vertebrae, were observed at 40 mg/kg-day, the HDT. The developmental LOAEL is 40 mg/kg-day, based on decreased fetal BWs and skeletal variations. The developmental NOAEL is 12 mg/kg-day (USEPA 2001e).

In another developmental toxicity study (MRID No. 41198901), diquat dibromide was administered by gavage to female New Zealand White rabbits at dose levels of 0, 1, 3, or 10 mg/kg-day (as diquat cation) on days 7 through 19 of gestation. The maternal LOAEL is 3 mg/kg-day, based on decreased maternal weight gain and food consumption. The maternal NOAEL is 1 mg/kg-day. Developmental effects occurred only in the high dose group, characterized as increases in the incidence of friable livers, mottled livers, partially ossified ventral tubercle of cervical vertebrae, and partially ossified and unossified sternebra. The developmental LOAEL is 10 mg/kg-day (the HDT), and the developmental NOAEL is 3 mg/kg-day (USEPA 2001e).

In a third developmental toxicity study (MRID No. 00061637), diquat dibromide was administered by gavage to female Alderley Park strain SPF albino mice at dose levels of 0, 1, 2, and 4 mg/kg-day (as diquat cation) on days 6 through 15 of gestation. The maternal LOAEL is 2 mg/kg-day, based on effects including a decreased maternal weight gain, piloerection, dyspnea, respiratory noise, and abnormal posture. The maternal NOAEL is 1 mg/kg-day. Developmental effects occurred only in the high dose group, characterized as

decreased fetal BW and increases in the incidence of skeletal alterations. The developmental LOAEL is 4 mg/kg-day (the HDT), and the developmental NOAEL is 2 mg/kg-day (USEPA 2001e).

Reproductive Toxicity

In a 2-generation reproduction study (MRID No. 41531301), diquat dibromide was administered continuously in the diet to Wistar rats at dose levels of 0, 16, 80, or 400/240 ppm (as diquat cation). Because adverse effects were seen in the F1 animals (i.e., the first generation animals), the high dose for the F0 animals (i.e., the parents) was reduced from 400 ppm to 240 ppm 4 weeks after selection. There were no treatment-related deaths. Parental toxicity was observed in both generations, mostly at the high-dose level, as increased incidences of clinical signs, ophthalmoscopic signs, decreased body-weight gains and decrease food consumption during the premating period. Ophthalmoscopic examination revealed partial/total cataracts at the high-dose level in both sexes and both generations following the premating dosing periods. At the high-dose level in both generations and both sexes, the incidence of partial and/or total cataract increased with time.

The systemic LOAEL is 4 mg/kg-day (80 ppm) based on decreased BW gain, decreased food consumption, and increased incidences of eye opacity, lenticular cataracts, and iritis. The systemic NOAEL is 0.8 mg/kg-day (16 ppm). The reproductive LOAEL is 400/240 ppm (20/12 mg/kg-day), based on a decreased number of live pups per litter and decreased pup BW gain. The reproductive NOAEL is 4 mg/kg-day (80 ppm; USEPA 2001e).

Neurotoxicity

In an acute neurotoxicity study (MRID No. 42666801), technical diquat dibromide was administered by gavage to Sprague-Dawley rats at dose levels of 0, 25, 75, or 150 mg/kg (as diquat cation). Diquat dibromide had no definite impact on neurotoxic responses in functional observational battery and motor activity measurements at 6 hours after dosing and on days 8 and 15. Clinical evidence of neurotoxicity included increased incidence of diarrhea and nasal staining in females in the 75 mg/kg group. Females in the 150 mg/kg group showed additional effects of piloerection, upward curvature of the spine, hunched posture, and tip toe gait. The systemic NOAEL is 75 mg/kg, based on clinical signs and decreased body-weight gain at the systemic LOAEL of 150 mg/kg (USEPA 2001e).

In a subchronic neurotoxicity study (MRID No. 42616101), technical diquat dibromide was administered in the diet to Alpk:APfSD rats at dose levels of 0, 20, 100, or 400 ppm for 13 weeks. Treatment-related toxic effects observed in the 400 ppm group included decreased BWs, decreased BW gain, decreased food utilization, incidence of total cataracts, and posterior opacities of the lens. There was no evidence of neurotoxicity. The NOAEL for neurotoxicity is 400 ppm (32.4 mg/kg-day for males, 38.5 mg/kg-day for females), the HDT. The systemic NOAEL is 100 ppm (8.0 mg/kg-day for males, 9.5 mg/kg-day for females), based on cataracts, decreased body-weight gain and food utilization at the systemic LOAEL for this study of 400 ppm (32.4 mg/kg-day for males, 38.5 mg/kg-day for females; USEPA 2001e).

Mutagenicity

Diquat dibromide was found to be negative for mutagenic potential in several assays. These included microbial gene mutation assays (Ames assays using five strains of *Salmonella typhimurium* and one strain of *Escherichia coli*; MRID No. 40323103), two structural chromosome aberration tests, an *in vivo* mouse bone marrow micronucleus assay (MRID No. 40323104), an *in vivo* dominant lethal assay in mice (MRID No. 00061636), and assays of other genotoxic effects (e.g., unscheduled DNA synthesis in rat hepatocytes *in vitro*; MRID No. 40323107).

Diquat dibromide was positive in one gene mutation test (*in vitro* mouse lymphoma cell assay; MRID No. 40323101), in one chromosome aberration test (*in vitro* human blood lymphocytes from one male and one female donor; MRID No. 40323106; USEPA 1995), and in an *in vitro* genotoxicity assay. However, the response was generally weak and was observed at cytotoxic levels (levels that are toxic to the cell; USEPA 2001e).

Metabolism

In a rat metabolism study (MRID No. 0055107), [^{14}C]-labeled diquat dibromide was administered to rats. Ninety percent of the orally administered dose was eliminated in feces indicating poor gastrointestinal absorption. In addition, rats injected subcutaneously with [^{14}C]-diquat dibromide excreted nearly all of the labeled material in the urine within 2 days (USEPA 2001e).

Following a single oral dose of 60 mg/kg (in the form of the diquat cation) of [^{14}C]-diquat dibromide, only 5

percent of the radioactivity was recovered in the urine within 7 days (MRID No. 00065592). Whole body autoradiography indicated that diquat dibromide was initially concentrated in the cartilaginous tissues, liver, and bladder. After 24 hours, the only radioactivity detected was in the bladder and intestines. Feeding 250 mg/kg (as the diquat cation) of unlabeled diquat dibromide to rats for 2, 4, or 8 weeks resulted in no accumulation of diquat dibromide in tissues including brain, liver, lung, stomach, small and large intestines, muscle, and blood. The kidneys retained 0.18 to 1.17 ppm of diquat dibromide for 2 to 8 weeks (USEPA 1995).

Labeled [^{14}C]-diquat dibromide was administered to rats by stomach tube or by subcutaneous injection (doses not specified) for 4 days (MRID No. 00065593). The rats excreted 6.3% of the orally administered diquat dibromide in urine and 89.3% in feces within four days, most during the first 48 hours (5.3% was unmetabolized diquat and 1% was diquat monopyridone, diquat dipyridone, and unidentified metabolites). Of the radioactivity in the sulfuric acid-extractable fraction (65.5%), 57.1% was unmetabolized diquat, 4.3% was diquat monopyridone, and 4.1% represented unidentified metabolites. Following subcutaneous administration, 87.1% of the dose was recovered in the urine within 4 days (5% within 24 hours), and 78.8% of the radioactivity was unmetabolized diquat. The amounts of other metabolites were not reported (USEPA 1995).

Fluridone

Fluridone is a systemic herbicide used to manage aquatic vegetation on ponds, lakes, reservoirs, canals, and rivers. Fluridone is absorbed from the water by the shoots of submerged plants and from the hydrosoil by the roots of aquatic vascular plants. It acts by inhibiting the synthesis of carotenoid pigments that protect chlorophyll from photodegradation. In the absence of the colored carotenoid beta-carotene, chlorophyll is destroyed and chloroplasts are disrupted in the sunlight, causing cellular bleeding. Affected plants become white or chlorotic at growing points and slowly die (Bartels and Watson 1978 *cited in* McLaren/Hart 1995, USEPA 1986a).

Acute Toxicity

Table B-2 lists the toxicity categories for fluridone (technical). The USEPA (1986a) reported that technical grade fluridone is in Toxicity Category IV (very slight) for acute oral exposure in the rat. This is supported by oral LD_{50} values of more than 10,000 mg/kg for both the rat and the mouse (Elanco 1981 *cited in* McLaren/Hart 1995, SePRO 2002).

A dermal LD_{50} of greater than 500 mg/kg with no skin irritation was originally reported for rabbits exposed to technical fluridone (USEPA 1986b), but an LD_{50} value of greater than 2,000 mg/kg was later reported (USEPA 1988 *cited in* Massachusetts Department of Environmental Management/Massachusetts Department of Environmental Protection ((MA DEM/MA DEP) 2003). SePRO (2002) cites an LD_{50} of more than 5,000 mg/kg with no signs of systemic toxicity for the rabbit. The more recently reported values place fluridone in Category III (slight) for acute dermal effects.

The USEPA reported that fluridone is moderately toxic through acute inhalation exposure, equivalent to Toxicity Category II (USEPA 1986a). However, LC_{50} values for rats exposed to technical fluridone at concentrations of 2.13 mg/L (1 hour exposure) and 4.12 mg/L (4 hour exposure; USEPA 1986b and SePRO 2002), indicate that fluridone is in Category III (slight) for acute inhalation effects.

Eye irritation has been demonstrated as moderate to severe in rabbits with effects including redness, corneal dullness, and conjunctivitis, placing fluridone in Category II (USEPA 1986a, USEPA 1988 *cited in* MA DEM/MA DEP 2003). However, the manufacturer states that ocular irritation was not persistent and resulted primarily from the abrasive nature of the technical material, therefore fluridone should be in Category IV (slight) for eye irritation effects (SePRO 2002). Fluridone was found to be neither irritating nor a sensitizer to rabbit skin at 2,000 mg/kg (USEPA 1988 *cited in* MA DEM/MA DEP 2003), thus placing fluridone in Category IV for primary skin irritation, and designating fluridone as not a skin sensitizer.

Subchronic Toxicity

In a subchronic feeding study, rats were fed a test diet containing technical fluridone at a range of dose levels including 0, 330, and 1,400 ppm for a period of 90 days (MRID No. 00135208; USEPA 1986b, USEPA 1988 *cited in* MA DEM/MA DEP 2003). Effects observed at the 1,400 ppm level included increased liver and kidney weights as well as histological identification of liver centrilobular hypertrophy (USEPA 1986b). A NOAEL of 30 mg/kg-day is reported in USEPA (1988 *cited in* MA DEM/MA DEP 2003), based on increased liver weights at the 166 mg/kg-day level and no treatment-related effects at the 330 ppm level. A NOAEL of 53

mg/kg-day is cited in McLaren/Hart (1995) and referenced to the New York State Department of Health (NYSDOH 1986), but no information on the derivation of the NOAEL is provided. The USEPA (2002a) does not cite a NOAEL for this study, but reports a LOAEL of 166 mg/kg-day based on increased liver weights at the LDT.

In a subchronic feeding study, mice were dosed with fluridone at a range of levels including 0, 62, and 560 ppm in the diet for 90 days (USEPA 1986b, USEPA 1988 *cited in* MA DEM/MA DEP 2003). Effects observed at the 560 ppm level included histological identification of liver centrilobular hypertrophy (USEPA 1986b). Morphological changes in the liver and an increase in absolute liver weight in males at a fluridone concentration of 0.033% are reported in USEPA (1988 *cited in* MA DEM/MA DEP 2003). Partial enlargement of livers was observed at the 16.5 mg/kg-day level and no treatment-related effects at the 62 ppm level. A NOAEL of 9.3 mg/kg-day is cited in McLaren/Hart (1995) and referenced to NYSDOH (1986), but no information on the derivation of the NOAEL is provided. The USEPA (2002a) does not cite this study.

In a subchronic feeding study in dogs, fluridone was administered in the diet at a range of dose levels up to 200 mg/kg-day for 90 days (MRID No. 0082234). A NOAEL of 200 mg/kg-day is based on the observation of no treatment-related effects at the HDT (Elanco 1978a as *cited in* USEPA 2002a).

In a subchronic dermal toxicity study; fluridone was applied to rabbit skin at doses including 0, 192, 384, and 768 mg/kg-day for 21 days (MRID No. 00070933). An increase in organ weight was noted at 384 mg/kg-day. The NOAEL for systemic effects was determined to be the HDT of 768 mg/kg-day, since no systemic effects were noted at any dose. A NOAEL for dermal effects was not determined since dose-dependent skin irritation was observed at all doses (USEPA 1988 *cited in* MA DEM/MA DEP 2003; SePRO 2002).

Chronic Toxicity/Carcinogenicity

In a combined chronic toxicity/carcinogenicity study in rats, male and female Fischer rats were fed test diets containing technical fluridone at dietary concentrations of 0, 200, 650, or 2,000 ppm (0, 8, 25, or 81 mg/kg-day) for a period of 104 weeks (MRID Nos. 00103251, 00103305). Treatment-related effects observed at 650 ppm included glomerulonephritis, atrophic testes, eye keratitis, and decreased BW and organ weights. The NOAEL for systemic toxicity was set at 200 ppm (equal to 8 mg/kg-day). There was no evidence of oncogenic potential of fluridone at any dose levels tested (USEPA 2002a).

In a combined chronic toxicity/carcinogenicity study in mice, mice were administered fluridone concentrations in the diet including 0, 100, and 330 ppm for 104 weeks (MRID Nos. 00103252, 00103305). According to USEPA (1988 *cited in* MA DEM/MA DEP 2003), there was a dose-dependent increase in alkaline phosphatase in males exposed at the HDT of 330 ppm. No other toxic effects or lesions are reported at any other doses. The clinical NOAEL is equal to the HDT as evidenced by no deaths, no obvious toxic effects, and no histopathological lesions. McLaren/Hart (1995) reports a NOAEL for systemic toxicity of 11.6 mg/kg-day from this study (NYSDOH 1986). A NOAEL of 15 mg/kg-day (equal to 100 ppm) is reported by USEPA (2002a). There was no evidence of oncogenic potential of fluridone at any of the dose levels tested.

In a 1-year chronic feeding study in which dogs were administered fluridone by capsule in food, several effects including weight loss, increased liver weight and increased levels of alkaline phosphatase were reported at a dose level of 150 mg/kg-day (MRID No. 00103336); a NOAEL of 75 mg/kg-day was extrapolated from this study (USEPA 1988 *cited in* MA DEM/MA DEP 2003, USEPA 2002a).

Developmental Toxicity

In an initial developmental toxicity study in which rats were exposed to up to 200 mg/kg-day of fluridone, no developmental effects were observed at any of the levels tested. However, the study was not useful for regulatory purposes because no maternal toxicity or fetotoxicity was seen at the HDT (200 mg/kg-day); therefore, the USEPA requested that a second study be conducted (USEPA 1986a).

In a subsequent rat developmental toxicity study, rats (second species) were administered fluridone by oral gavage in doses of 0, 100, 300, or 1,000 mg/kg-day (MRID No. 00159963). At 300 mg/kg-day there was a decrease in maternal BW, and a maternal NOAEL of 100 mg/kg-day was established. At 1,000 mg/kg-day fetal weight loss and delayed ossification were noted; therefore the NOAEL for developmental effects was established at 300 mg/kg-day. Teratogenic effects (skeletal abnormalities in the fetus) were not observed in any dose group, so a teratogenic NOAEL of 1,000

mg/kg-day was established at the HDT (USEPA 1988 *cited in* MA DEM/MA DEP 2003, USEPA 2002a).

In a pilot developmental toxicity study, rabbits were exposed to fluridone doses of 0, 250, 500, 750, or 1,000 mg/kg-day. A maternal NOAEL of 500 mg/kg-day (based on effects on the mother) was identified resulting from maternal weight loss at the 750 mg/kg-day dose level. Fetal resorptions occurred in the 500 mg/kg-day dose group, and consequently the developmental NOAEL (based on effects on the offspring) in this study was set at 250 mg/kg-day (USEPA 1988 *cited in* MA DEM/MA DEP 2003).

In a separate developmental toxicity study, rabbits were exposed to 0, 125, 300, or 750 mg/kg-day of fluridone during gestation (MRID No. 00103302 [USEPA 2002a], MRID No. 00263157 [USEPA 2003a]). Effects including maternal weight loss and abortion were noted at the 300 mg/kg-day dose level. Therefore, the maternal NOAEL for this study was set at 125 mg/kg-day. Teratogenic effects were not observed at any dose, so the NOAEL for teratogenic effects is the HDT, or 750 mg/kg-day (USEPA 1988 as *cited in* MA DEM/MA DEP 2003; USEPA 2002a).

Reproductive Toxicity

In a 3-generation reproduction study, technical fluridone was administered continuously in the diet to rats at dose levels of 0, 650, and 2,000 ppm (MRID No. 00103304). Since no maternal or teratogenic effects were observed at the HDT of 2,000 ppm, the maternal and teratogenic NOAEL is 2,000 ppm (100 mg/kg-day). The developmental NOAEL is 650 ppm (32.5 mg/kg-day), based on decreased pup weight reported at the 100 mg/kg-day level (USEPA 2002a).

Neurotoxicity

Studies of fluridone neurotoxicity were not identified. No clinical signs of neurotoxicity or neuropathology were reported in any of the chronic or reproductive toxicity studies conducted.

Mutagenicity

Mutagenicity assays submitted for fluridone do not indicate potential for genotoxicity, gene mutation, or structural chromosomal aberration (USEPA 1986a). Fluridone was found to be negative for mutagenic potential in four assays: fluridone did not induce bacterial mutations in the Ames assay at the highest tested concentration of 1,000 ppm; a fluridone intraperitoneal dose of 500 mg/kg did not induce sister chromatid exchange in Chinese hamster bone marrow cells; fluridone did not promote unscheduled DNA synthesis in rat hepatocytes when tested at a concentration of 300 ppm; and a single oral dose of 2,000 mg/kg did not cause dominant lethal mutations in male rats (USEPA 1988 *cited in* MA DEM/MA DEP 2003; SePRO 2002).

Metabolism

The residue of concern in drinking water is the parent compound fluridone (USEPA 1986a). The primary metabolite of fluridone in fish is Metabolite II[1]. Metabolite II was identified as the major metabolite in laboratory hydrosoil studies. N-methyl formamide (NMF) was identified as a photolytic breakdown product in a laboratory study cited in McLaren/Hart (1995). Scientists were concerned with NMF being produced by the breakdown of fluridone since NMF has been shown to be teratogenic in rabbits at high doses and can penetrate human skin; however, NMF has not been identified in the natural environment (McLaren/Hart 1995).

Absorption/excretion studies in rats indicate that a single oral dose of fluridone is rapidly absorbed, extensively metabolized and primarily excreted in the feces. The dose was excreted in 72 hours. More than 80% was excreted in the feces and a trace was excreted in the urine (Arnold 1979 *cited in* McLaren/Hart 1995).

Imazapic

Imazapic is a member of the imidazolinone class of herbicides that selectively inhibit acetohydroxyacid synthetase, an enzyme in certain plant's biosynthetic pathway of three amino acids–valine, leucine, and isoleucine. In contrast to plants, mammals do not possess the pathway to synthesize these three amino acids, and therefore are not susceptible to the primary effect pathway of imazapic (USEPA 2001a).

Acute Toxicity

Table B-2 lists the toxicity categories for imazapic. Imazapic results in low acute toxicity by oral, dermal, and inhalation routes of exposure, as well as eye and skin irritation (all studies are in Toxicity Category III or

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[1] 1-methyl-3-(4-hydroxyphenyl)-5-[3-(trifluoromethyl)phenyl]-4(1H)-pyridinone

IV). Imazapic is not a dermal sensitizer (USEPA 2001a).

Subchronic Toxicity

A 21-day dermal toxicity study in rabbits was conducted (MRID No. 42711420) where imazapic was applied to the clipped backs of New Zealand albino rabbits at targeted doses of 0, 250, 500, or 1,000 mg/kg-day for 6 hours per day, 5 days per week, for 3 weeks. There were no systemic or developmental effects observed up to the HDT (1,000 mg/kg-day), therefore a toxicity endpoint was not selected from this study (USEPA 2001a).

Chronic Toxicity/Carcinogenicity

In a 24-month combined chronic feeding and carcinogenicity study (MRID No. 43320307), imazapic was administered in the diet to groups of 65 male and 65 female Sprague-Dawley strain rats at doses of 0, 5,000, 10,000 or 20,000 ppm. At the highest dose level tested (20,000 ppm), no treatment-related effects were observed. Also, no treatment-related increase in tumors of any kind was observed at any dose level. The NOAEL in this study for both male and female rats is the HDT, 20,000 ppm (1,029 mg/kg-day for males and 1,237 mg/kg-day for females). A LOAEL was not determined.

In an 18-month chronic feeding/carcinogenicity study (MRID No. 43320306), imazapic was administered in the diet to groups of 65 male and 65 female CD-1 strain mice at dose levels of 0, 1,750, 3,500 or 7,000 ppm. At the highest dose level tested (7,000 ppm, the HDT), no treatment-related effects were observed in either male or female mice. Statistically significant decreases in high- and mid-dose male BWs during the first 26 weeks of the study were not convincing indicators of toxicity because the decreases were small, were noted even before initiation of treatment, and were not dose-related. No treatment-related increase in tumors of any kind was observed in either male or female mice at any dose level. The NOAEL in this study for both male and female mice is 7,000 ppm (1,134 mg/kg-day for males and 1,442 mg/kg-day for females). A LOAEL was not determined (USEPA 2001a).

Developmental Toxicity

In a developmental toxicity study (MRID No. 42711422), groups of 25 impregnated Sprague-Dawley rats were administered imazapic via gavage at daily doses of 0, 250, 500 or 1,000 mg/kg-day on gestational days 6 through 15. There were no treatment-related effects on mortality, abortions, clinical signs, BW, BW gain, food consumption, or Caesarian section parameters at any of the doses, including 1,000 mg/kg-day. Therefore, the maternal NOAEL is 1,000 mg/kg-day, and the maternal LOAEL is greater than 1,000 mg/kg-day. There were no treatment-related effects on resorptions, pre- and post-implantation losses, fetal BW and sex ratio, or external, visceral, and skeletal malformations and anomalies. Therefore, the developmental NOAEL is 1,000 mg/kg-day, and the developmental LOAEL is greater than 1,000 mg/kg-day.

In a developmental toxicity study (MRID No. 42711423), groups of 20 impregnated New Zealand White rabbits were administered imazapic via gavage during gestation days 7 through 19 at daily doses of 0, 175, 350, 500, or 700 mg/kg-day. The occurrence of only seven litters at 700 mg/kg-day precluded a meaningful evaluation of developmental findings at this dose, therefore this dose was not considered further in the study. The LOAEL for maternal toxicity is 500 mg/kg-day based on decreased BW gain and food consumption during the dosing period. The NOAEL for maternal toxicity is 350 mg/kg-day. Although there was an increase in fetal incidences of rudimentary ribs, the study authors concluded that these effects are not related to the treatment. Therefore, the NOAEL for developmental toxicity was set at 500 mg/kg-day, and the LOAEL for developmental toxicity is greater than 500 mg/kg-day (USEPA 2001a).

Reproductive Toxicity

In a 2-generation rat reproduction study (MRID No. 43320305), imazapic was administered by diet to two groups of 30 per sex Sprague-Dawley rats at levels of 0, 5,000, 10,000, or 20,000 ppm. There were no compound-related effects in any parameter evaluated in either male or female parental animals or offspring of the first or second generation. Therefore, the parental, reproductive, and offspring NOAELs are 20,000 ppm, and the LOAELs are greater than 20,000 ppm (USEPA 2001a).

Neurotoxicity

There are no neurotoxicity studies in rats or hens (which are a common test species for neurotoxic effects), and there were no neurotoxic clinical signs or histopathology observed in any of the other toxicity studies with imazapic (USEPA 2001a).

Mutagenicity

Imazapic was found to be negative in the following mutation assays: a reverse gene mutation assay using *Salmonella* strains (MRID No. 42711424); a chromosome aberration assay in Chinese hamster ovary cells (MRID No. 42711427); a forward mutation assay in Chinese hamster ovary cells (MRID No. 42711425); and a rat bone marrow/chromosomal aberration assay (MRID No. 42711426; USEPA 2001a).

Metabolism

A rat metabolism study demonstrated that only the unchanged parent compound was detected in the urine, which was the major route of excretion. These results indicated that imazapic was not metabolized to other compounds. There was no evidence of bioaccumulation of imazapic in tissues (USEPA 2001a).

Sulfometuron Methyl

Sulfometuron methyl is a non-selective, sulfonyl urea herbicide used mainly to control the growth of broadleaf weeds and grasses. The mode of action for the sulfonyl urea class is the inhibition of the synthesis of essential amino acids (Syracuse Environmental Research Associates [SERA] 1998).

Acute Toxicity

The USEPA has not developed acute toxicity categories for sulfometuron methyl (USEPA 2003b). Acute oral exposure to sulfometuron methyl results in a low order of toxicity. Neither mortality nor overt signs of toxicity were observed in rats given single oral doses of up to 17,000 mg/kg (Trivits 1979 *cited in* SERA 1998, Dashiell and Hall 1980, Dashiell and Hinckle 1980, Filliben 1995). The acute dermal toxicity of the compound is also low. The LD_{50} values for exposure through the skin ranges from over 2,000 mg/kg in female rabbits to over 8,000 mg/kg in male rabbits (USEPA 1990 *cited in* Extoxnet 1996b). The technical compound, Oust®, is not a skin irritant or skin sensitizer (USEPA 1990 *cited in* Extoxnet 1996b), but it has mild eye irritant properties in rabbits (Fletcher et al. 1993 *cited in* Extoxnet 1996b). The acute inhalation LC_{50} is above 5.3 mg/L in rats, indicating its slightly toxic nature by this route (Weed Science Society of America 1994 *cited in* Extoxnet 1996b).

Subchronic Toxicity

The most common signs of toxicity from sulfometuron methyl involve hemolytic anemia and decreased BW gain (SERA 1998). In one subchronic study, 3,400 mg/kg-day sulfometuron methyl was administered to six rats for 14 days (Hinckle 1979 *cited in* SERA 1998), and the investigators observed reduced testicular size in one rat and mild testicular lesions in another. No such effects were observed in any of the six control rats.

Chronic Toxicity/Carcinogenicity

Several toxic effects have been noted with chronic exposure to sulfometuron methyl in test animals. At doses of 25 mg/kg-day, dogs experienced reduced red blood cell counts and increased liver weight (Wood and O'Neal 1983 *cited in* Extoxnet 1996b). In this study, dogs were fed the compound in their food for a year. In a 2-year feeding study on rats, no effects were noted below 7.5 mg/kg-day (USEPA 1990 *cited in* Extoxnet 1996b).

In chronic bioassays conducted in mice (Summers 1990 *cited in* SERA 1998) and rats (Mullin 1984 *cited in* SERA 1998), toxicity was indicated by hematological changes in the high dose groups of both studies. Carcinogenicity was not demonstrated in either study.

Developmental Toxicity

Two teratogenicity studies were conducted in which rabbits were exposed to sulfometuron methyl by gavage. The study by Hoberman et al. (1981 *cited in* SERA 1998) involved relatively high dose levels (100 to 1,000 mg/kg BW), while the study by Serota et al. (1981 *cited in* SERA 1998) involved dose levels of 30 to 300 mg/kg BW. In the Hoberman et al. (1981) study, signs of maternal toxicity, including death in some female parents, were apparent at all dose levels. Possible spontaneous abortions were noted at doses of 300 mg/kg or greater. In the lower dose study by Serota et al. (1981), there were no signs of toxicity in the dams or offspring. Nonetheless, the investigators observed an increased number of fetuses with anomalies as well as an increase in the proportion of fetal anomalies per litter, compared with controls (SERA 1998).

Reproductive Toxicity

There are three reproduction studies involving dietary exposure of rats to sulfometuron methyl (Wood et al. 1980; Lu 1981; Mullin 1984 *cited in* SERA 1998). Decreases in maternal BW gain associated with

decreased food consumption and hematological changes were the most common effects observed in these studies. Dietary levels of 5,000 ppm were associated with changes in developmental parameters, including decreased fetal weight (Lu 1981) and a decreased number of pups in the F1 and F2 generations (Mullin 1984). In addition to these effects, mean absolute brain weights decreased significantly in male rats (Mullin 1984).

Neurotoxicity

Specific neurotoxicity studies are not available in the database (SERA 1998).

Mutagenicity

Sulfometuron methyl did not show mutagenic activity in assays of *Salmonella typhimurium* strains TA 1535, TA 1537, TA 98 and TA100 (Taylor 1979 *cited in* SERA 1998) and of Chinese hamster ovary cells (Krahn and Fitzpatrick 1981 *cited in* SERA 1998). Sulfometuron methyl did not induce chromosomal damage in Chinese hamster ovary cells (Galloway 1981 *cited in* SERA 1998) or unscheduled DNA synthesis in rat hepatocytes (Ford 1982 *cited in* SERA 1998).

Metabolism

In both mammals and bacteria, sulfometuron methyl is degraded by cleavage of the sulfonyl urea bridge to form sulfonamide and a dimethyl pyrimidine urea or pyrimidine amine. Sulfonamide may be further degraded by demethylation to the free benzoic acid which, in turn, may undergo a condensation reaction to form saccharin. At least in bacteria, the pyrimidine metabolites may be degraded further to hydroxypyrimidine amine and pyrimidine-ol. Although data regarding mammalian metabolism of sulfometuron methyl are limited, there is an apparent qualitative difference between mammalian and microbial metabolism that involves changes to sulfometuron methyl prior to cleavage of the sulfonyl urea bridge. In mammals, the major metabolic route seems to involve hydroxylation of a methyl group on the pyrimidine ring (Koeppe and Mucha 1991 *cited in* SERA 1998); in bacteria, the major metabolic pathway seems to involve demethylation of the methyl ester group on the benzoate ring (Monson and Hoffman 1990 *cited in* SERA 1998).

Dose-response Assessment

The purpose of the dose-response assessment is to identify the types of adverse health effects a chemical may potentially cause and to define the relationship between the dose of a chemical and the likelihood or magnitude of an adverse effect (response). The dose-response assessment identifies quantitative or numerical dose-response values that are used in risk calculations to derive risk estimates. The dose-response values used in the HHRA were developed by the USEPA.

Adverse effects are defined by the USEPA as either potentially carcinogenic or noncarcinogenic (i.e., potential effects other than cancer). Dose-response values for these types of effects are defined by the USEPA. None of the six herbicides evaluated in this HHRA are designated as potential carcinogens by the USEPA; therefore, this toxicity assessment focuses on noncarcinogenic effects.

Types of Dose-response Values

Under USEPA OPP guidance (USEPA 2000a), noncarcinogenic effects are evaluated differently depending on whether the assessment is of a dietary or non-dietary (occupational or residential) exposure, as described below.

Dietary Assessment

For noncarcinogenic effects, toxicity is represented by a Population Adjusted Dose (PAD) and may be calculated for acute effects (i.e., acute PAD) or chronic effects (i.e., chronic PAD). A PAD is an acute or chronic reference dose (RfD) divided by the Food Quality Protection Act (FQPA) Safety Factor (SF). Both the RfD and the FQPA are discussed below.

Under the provisions of the FQPA of 1996, the USEPA is directed to consider aggregate exposure, cumulative risk, and additional sensitivity of infants and children. The FQPA SF is applied to pesticides that exhibit threshold effects to "take into account potential pre- and post-natal toxicity and completeness of the data with respect to exposure and toxicity to infants and children." In applying the factor, the agency takes into account information on the toxicity of the pesticide as well as the completeness of the toxicity and exposure databases. Generally, FQPA SFs range from 1 to 10.

Reference doses are derived by identifying a NOAEL, which is obtained from the acute or chronic toxicity studies, and dividing the NOAEL by the appropriate uncertainty factors (UFs). The NOAEL is typically derived from animal studies where animals are dosed with different amounts of the pesticide. Typically for pesticides, a 10-fold factor is applied to account for

variation within the human population (intraspecies), and an additional 10-fold factor is applied to account for the differences between humans and animals (interspecies). The following equations show the definitions of PAD and RfD:

$$PAD = \frac{RfD}{\text{FQPA Safety Factor}}$$

where

$$RfD = \frac{NOAEL}{\text{Uncertainty Factors}}$$

In the acute PAD calculation, the acute RfD and the NOAEL obtained from an acute toxicity study are used in the equation. For the chronic PAD calculation, the chronic RfD and the NOAEL obtained from a chronic study are used (USEPA 2000a).

The dietary exposures evaluated in this risk assessment are ingestion of drinking water, berries, and fish for the public receptors.

Non-dietary (Occupational or Residential) Assessment

For evaluating noncancer effects for non-dietary exposures, toxicity is represented by the NOAEL. The NOAEL is divided by the intake rate to calculate a Margin of Exposure (MOE). No Observed Adverse Effect Levels are identified for a variety of exposure durations and exposure routes:

- Short-term oral NOAEL
- Intermediate-term oral NOAEL
- Short-term dermal NOAEL
- Intermediate-term dermal NOAEL
- Long-term dermal NOAEL
- Short-term inhalation NOAEL
- Intermediate-term inhalation NOAEL
- Long-term inhalation NOAEL

In the current USEPA OPP program, short-term is defined as 1 day to 1 month, intermediate-term is defined as 1 to 6 months, and long-term is defined as greater than 6 months (USEPA 2001g). In general, NOAELs decrease as exposure time (ET) increases. This is because the dose encountered is a factor of concentration and duration of exposure. A study conducted by the California EPA's Office of Environmental Health Hazard Assessment (OEHHA) indicates that both concentration and time of exposure contribute to the overall severity of toxic effects. In fact, "Haber's Law" states that the product of the concentration and time of exposure required to produce a specific physiologic effect is equal to a constant level or severity of response (OEHHA 1999). The USEPA has not developed long-term oral NOAELs, since long-term oral exposure is similar to dietary exposure, which is represented by PADs. The short-term and intermediate-term oral NOAELs are used to represent incidental ingestion exposures, such as ingesting water while swimming. NOAELs represent non-dietary exposures and are used to evaluate the occupational receptors and the public receptors for the following scenarios: dermal contact with spray, dermal contact with foliage, dermal contact with water while swimming, and incidental ingestion of water while swimming.

For each of the six herbicides evaluated in this HHRA, the USEPA has developed NOAELs for a limited set of exposure durations and exposure routes. In other words, not all of the NOAELs listed above have been developed for the six herbicides.

The NOAEL divided by the intake results in the MOE. Unless specified otherwise, the target MOE is 100. The target MOE accounts for uncertainties in the NOAEL. Margins of Exposure greater than the target MOE indicate no significant risk. For each of the herbicides, the target MOE is listed along with the dose-response values in Table B-3.

Available Dose-response Values

For diflufenzopyr, diquat and imazapic, the USEPA provided documents (such as reports from the Hazard Identification Assessment Review Committee and Health Effects Division) that showed the derivation of various PADs and NOAELs for different exposure routes and time frames (short-, intermediate-, and long-term). At the BLM's request, the USEPA reviewed the available toxicity information for fluridone (USEPA 2003a) and sulfometuron methyl (USEPA 2003b), and developed PADs and NOAELs for oral, dermal, and inhalation exposures. For fluridone, the USEPA did not develop dietary PADs; therefore, a chronic oral RfD listed in USEPA's Integrated Risk Information System (IRIS) database (USEPA 2003c) is used to evaluate chronic dietary exposures for fluridone.

Table B-3 shows the USEPA-derived PADs and NOAELs for each of the six herbicides. As shown in Table B-3 and as previously stated, none of these herbicides are considered potential carcinogens. For some of the herbicides, USEPA-derived values were not available for certain exposure routes and time periods. In some cases, these values were not derived because the herbicide had not been found to be toxic through that particular route of exposure (such as dermal NOAELs for diflufenzopyr). In other cases, these values were not derived because the USEPA had determined that the use of the specific herbicide did not indicate a concern for exposure through a specific route (such as a long-term inhalation NOAEL for diflufenzopyr). However, since this risk assessment evaluated both occupational and public exposures through a variety of exposure routes, it was important to have toxicity values for certain exposures and time frames even if these values had not been derived by USEPA. Therefore, if information was available, surrogate toxicity values for certain exposures and time periods were derived in this risk assessment.

Dicamba

The USEPA has developed various dose-response values specific to different toxicological endpoints. Table B-3 summarizes the dose-response values for dicamba. As shown here, dicamba and diflufenzopyr are evaluated as separate chemicals, even though they are present in the same herbicide formulations. This is a reasonable approach because dose-response values for the two chemicals are based on different toxicological endpoints. For example, the acute PAD and chronic PAD for dicamba are based on neurological effects and developmental effects, respectively. For diflufenzopyr, on the other hand, the acute PAD and chronic PAD are based on developmental effects and hemolytic effects, respectively. The oral, dermal, and inhalation NOAELs for dicamba are based on developmental effects, whereas the oral and inhalation NOAELs for diflufenzopyr are based on hemolytic effects. Therefore, for the HHRA, dicamba and diflufenzopyr were evaluated separately.

Dose-response Values for Dietary Exposures

Acute Dietary PAD. An acute PAD of 1.0 mg/kg-day was developed based on an acute neurotoxicity study in rats. The LOAEL for this study was 300 mg/kg-day based on various neurological effects. No NOAEL was identified since this was the LDT. An RfD of 1.0 mg/kg-day was calculated by dividing the LOAEL by a UF of 300. The UF of 300 consists of two factors of 10 to account for interspecies and intraspecies differences. A factor of 3 was included because of the use of a LOAEL rather than a NOAEL. It was determined that a UF of 3 is adequate based on comparison with a rat developmental toxicity study that had similar clinical signs with a LOAEL of 400 mg/kg-day that showed no progression or worsening of the effects after 10 days of treatment (USEPA 2001g).

The USEPA has not developed an FQPA SF for this chemical. However, based on the mild toxicological effects at the LOAEL and the adequacy of developmental toxicity studies that evaluate risks to the offspring, it is assumed that the FQPA SF is 1 and that the acute PAD is the same as the acute RfD of 1.0 mg/kg-day.

Chronic Dietary PAD. The USEPA has developed a chronic dietary PAD of 0.45 mg/kg-day. This value was based on a NOAEL of 45 mg/kg-day based on a multi-generation reproduction study in rats. Decreased offspring growth was observed at the LOAEL of 136 mg/kg-day. A chronic RfD was calculated by dividing the chronic NOAEL by a UF of 100 (45 mg/kg-day / 100 = 0.45 mg/kg-day). The FQPA SF is likely to be 1, since this study considers effects on young animals. Therefore, the chronic PAD is equal to the chronic RfD at 0.45 mg/kg-day (USEPA 2001h).

Dose-response Values for Non-dietary Exposures

Oral NOAELs. The short-term and intermediate-term oral NOAELs are 45 mg/kg-day based on the multi-generation rat reproduction study on which the chronic PAD is based. The USEPA commented that this study is of the appropriate route and duration of exposure, including short-term, since effects were seen on lactation day 21 in the second-generation litters and is protective of infants and children (USEPA 2001h).

Dermal NOAELs. The USEPA has identified short-term, intermediate-term and long-term dermal NOAELs of 45 mg/kg-day based on the multi-generation rat reproduction study on which the chronic PAD is based. The USEPA noted that although a 21-day dermal study was available, showing no systemic toxicity at the HDT of 1,000 mg/kg-day, this dermal study did not assess reproductive and offspring effects. Offspring toxicity in the rat oral multi-generation reproduction study was noted below dosages where parental toxicity was evident. In order to be protective of these effects, the reproduction study was chosen for all time periods of exposure, including short-term, since effects in the

offspring were seen on lactation day 21 (USEPA 2001h).

The dermal NOAELs should be used with a dermal absorption factor (DAF) of 15%. The USEPA calculated this DAF by dividing the LOAEL of 150 mg/kg-day in the rabbit oral developmental study by the NOAEL of 1,000 mg/kg-day in the 21-day dermal toxicity rabbit study (150 mg/kg-day / 1,000 mg/kg-day x 100 = 15%; USEPA 2001h).

Inhalation NOAELs. The USEPA has identified short-term, intermediate-term and long-term inhalation NOAELs of 45 mg/kg-day based on the multi-generation rat reproduction study on which the chronic PAD is based. The USEPA states that this study is protective of effects in the offspring. In order to account for effects in the offspring in the absence of any route-specific data, the reproduction study was chosen for all time periods of exposure (USEPA 2001h).

Target Margin of Exposure. The target MOE for dicamba for the non-dietary NOAELs is 100 (USEPA 2001h).

Cancer Dose-response Value. The USEPA has not developed a cancer slope factor (CSF) for dicamba. The RfD/Peer Review Committee concluded that dicamba should be classified as a Group D carcinogen based on the lack of both rat and mouse bioassays being tested at high enough levels to induce any significant toxicity in the two different species (USEPA 2001h).

Diflufenzopyr

The USEPA has developed various dose-response values specific to different toxicological endpoints. Table B-3 summarizes the dose-response values for diflufenzopyr.

Dose-response Values for Dietary Exposures

Acute Dietary PAD. An acute PAD of 1.0 mg/kg-day was calculated for use in evaluating risks from dietary exposures for females 13 to 50 years old. This value was based on an acute dietary NOAEL of 100 mg/kg-day based on a rabbit developmental study. The LOAEL for this study is 300 mg/kg-day based on the occurrence of extra ribs and other skeletal variations in the rabbit developmental study. These effects can occur from a single dose, and females of reproductive age, i.e., aged 13 to 50, are the population subgroup of concern. The UF for deriving a human dose-response value is 100. Therefore, the acute RfD is 1.0 mg/kg-day (100 mg/kg-day / 100). The acute PAD was calculated by dividing the RfD by the FQPA SF. The USEPA has determined that the FQPA SF for diflufenzopyr is 1, indicating that children are unlikely to face higher risks, which is appropriate as the results are based on a developmental study. Therefore, the acute PAD is the same as the acute RfD of 1.0 mg/kg-day (USEPA 2002b).

The USEPA has not developed an acute dietary PAD for the general population, since appropriate studies involving single exposures were not available (USEPA 2002b). The acute PAD for females 13 to 50 years old therefore is used for all receptors.

Chronic Dietary PAD. The USEPA has developed a chronic dietary PAD for all populations of 0.26 mg/kg-day. This value was based on a NOAEL of 26 mg/kg-day derived from a 52-week dog feeding study. The LOAEL of 299 mg/kg-day was based on compensated hemolytic anemia in both sexes of dogs. A chronic RfD was calculated by dividing the chronic NOAEL by a UF of 100 (26 mg/kg-day / 100 = 0.26 mg/kg-day). The chronic PAD is also 0.26 mg/kg-day, since the FQPA SF is 1 (USEPA 2002b).

Dose-response Values for Non-dietary Exposures

Oral NOAELs. The USEPA has not derived non-dietary oral NOAELs for diflufenzopyr (USEPA 2002b). However, the USEPA established short- and intermediate-term inhalation NOAELs of 58 mg/kg-day based on a subchronic feeding study in dogs. Inhalation exposure assumes 100% absorption. This same 58 mg/kg-day NOAEL is recommended as the short- and intermediate-term oral NOAEL, since this value was based on a feeding study.

Dermal NOAELs. The USEPA has not identified dermal toxicological endpoints of concern, citing no effects at the limit dose of 1,000 mg/kg-day in a 21-day dermal toxicity study in rabbits. Therefore, the USEPA has determined that assessment of risk via the dermal route is not necessary (USEPA 2002b).

Inhalation NOAELs. The USEPA has developed a short-term and intermediate-term inhalation NOAEL of 58 mg/kg-day. This value is based on an oral NOAEL of 58 mg/kg-day from a subchronic oral dog study. The inhalation absorption factor (IAF) was assumed to be 100%, therefore the inhalation NOAEL is equal to the oral NOAEL. The LOAEL in this study was 403

TABLE B-3
Summary of Toxicological Endpoint Data

Parameter	Dicamba	Diflufenzopyr	Diquat	Fluridone	Imazapic	Sulfometuron-Methyl
Acute dietary NOAEL (mg/kg-day)	300[1]	100[2]	75	NA	NA[3]	NA[3]
Uncertainty factor	300	100	100	NA	NA	NA
Food Quality Protection Act safety factor	1	1	1	NA	NA	NA
Acute population adjusted dose (mg/kg-day)[4]	1	1	0.75	NA	NA	NA
Chronic dietary NOAEL (mg/kg-day)	45	26[5]	0.5 (0.22)[6]	8[7]	137[8]	5
Uncertainty factor	100	100	100	NA	300	100
Food Quality Protection Act safety factor	1	1	1	NA	1	1
Chronic population adjusted dose (mg/kg-day) (d)	0.45	0.26	0.005 (0.0022)[6]	0.08[9]	0.5	0.05
Short- and intermediate-term oral NOAEL (mg/kg-day)	45	**58**[10]	1 (0.5)[11]	25	350	5
Short-term dermal NOAEL (mg/kg-day)	45[12]	NA[13]	1[14]	25 (125)[15]	NA[16]	NA[17]
Intermediate-term dermal NOAEL (mg/kg-day)	45[12]	NA[13]	0.5[14]	25[15]	NA[16]	NA[17]
Long-term dermal NOAEL (mg/kg-day)	45[12]	NA[13]	0.5[14]	**8**[7]	137[18]	NA[17]
Short-term inhalation NOAEL (mg/kg-day)	45	58[19]	0.024	125[20]	350[21]	5[22]
Intermediate-term inhalation NOAEL (mg/kg-day)	45	58[20]	0.024	25[21]	350[22]	5[22]
Long-term inhalation NOAEL (mg/kg-day)	45	26[23]	0.024	8[7]	137[24]	5[22]
Target margin of exposure for oral, dermal, inhalation	100	100[25]	100	100[25]	300/100/300[26]	100
Cancer slope factor for oral, dermal, inhalation	NA	NA[27]	NA[28]	NA[28]	NA[28]	NA[29]
References	USEPA 2001h	USEPA 2002c	USEPA 2001f	USEPA 2003a	USEPA 2001a	USEPA 2003b

NA = Not applicable according to USEPA risk assessments.
Values in **bold** indicates where surrogate toxicity data have been used that were not provided in the USEPA documents.
Short term is defined as 1 day to 1 month, intermediate term is defined as 1 to 6 months, and long term is defined as over 6 months (USEPA 2001h).

TABLE B-3 (Cont.)
Summary of Toxicological Endpoint Data

[1] This value is a LOAEL based on an oral neurotoxicity study in rats.
[2] Derived for females of reproductive age (13 to 50 years). Based on a rabbit development study showing a LOAEL of 300 mg/kg-day.
[3] An endpoint attributable to a single dose was not identified.
[4] The PAD is the NOAEL divided by the uncertainty factor and the FQPA SF. If the FQPA SF is 1, then the PAD equals the Reference Dose (RfD), which is the NOAEL divided by the uncertainty factor.
[5] Derived for all populations. Based on a dog feeding study showing a LOAEL of 299 mg/kg-day.
[6] The numbers in parentheses are RfDs presented on IRIS (USEPA 2003c).
[7] The long-term dietary NOAEL of 8 mg/kg-day from the combined chronic rat feeding/carcinogenicity study on which USEPA's chronic RfD is based (http://www.epa.gov/iris/subst/0054.htm) is used as a chronic dietary NOAEL and as a long-term inhalation NOAEL.
[8] Lowest Observed Adverse Effect Level.
[9] Oral RfD value provided in IRIS (USEPA 2003c).
[10] Short- and intermediate-term inhalation NOAELs of 58 mg/kg-day were established by the Health Effects Division (USEPA 2002c) based on a subchronic feeding study in dogs. Therefore, assuming 100% absorption via inhalation, the inhalation NOAEL is used to evaluate the oral route of exposure.
[11] The short-term oral NOAEL is 1 mg/kg-day, and the intermediate-term oral NOAEL is 0.5 mg/kg-day.
[12] This value is modified using a dermal absorption factor (DAF) of 15% in the exposure calculations.
[13] No dermal or systemic toxicity was seen at 1,000 mg/kg-day in a 21-day dermal toxicity study in rabbits.
[14] This value is modified using a DAF of 4.1% in the exposure calculations.
[15] This value is modified using a DAF of 40% in the exposure calculations. The short-term dermal NOAEL is 25 mg/kg-day for children and 125 mg/kg-day for adults.
[16] No systemic toxicity was seen following repeated dermal application at 1,000 mg/kg-day over a 3-week period. Dermal quantification is not required.
[17] No systemic or dermal toxicity was seen following repeated dermal applications of up to 2,000 mg/kg-day to rabbits.
[18] The chronic dietary LOAEL of 137 mg/kg-day is used. The inhalation absorption factor is assumed to be 100%.
[19] Based on a subchronic dog feeding study showing a LOAEL of 403 mg/kg-day and assuming 100% inhalation absorption.
[20] The inhalation absorption factor is 100%.
[21] The short- and intermediate-term oral NOAEL is used—the inhalation absorption factor is assumed to be 100%; therefore, no adjustments are necessary for the exposure calculations.
[22] A 100% inhalation absorption fraction is used for route-to-route extrapolation from oral to inhalation.
[23] Assuming 100% absorption via inhalation, the chronic dietary NOAEL of 26 mg/kg-day was used as the long-term inhalation NOAEL (USEPA 2002c).
[24] The chronic dietary oral LOAEL is 137 mg/kg-day; this value must be modified using a DAF of 50% in the exposure calculations.
[25] Not listed, assumed to be 100.
[26] Target MOEs are 100 for short- and intermediate-term inhalation and short- and intermediate-term oral, and 300 for long-term inhalation and long-term dermal. The target MOE of 300 is necessary because the long-term dermal and inhalation values are LOAELs rather than NOAELs.
[27] Classified as not likely to be a human carcinogen.
[28] Classified as a Group E carcinogen - a chemical for which there is evidence of non-carcinogenicity in humans.
[29] Not yet evaluated by the USEPA, but no evidence of carcinogenicity in either mice or rats.

mg/kg-day based on the occurrence of erythroid hyperplasia in the bone marrow, extramedullary hemopoiesis in the liver, and hemosiderin deposits in Kupffer cells.

The USEPA has not developed a long-term inhalation NOAEL stating that, "the use pattern does not indicate a concern for potential exposure via this route. Therefore, this risk assessment is not required" (USEPA 2002b). However, since long-term use was evaluated in this risk assessment, a long-term inhalation NOAEL was derived from available information. The USEPA developed a chronic dietary NOAEL of 26 mg/kg-day based on a 52 week dog feeding study. Making the same assumption about inhalation absorption as made in developing the short- and intermediate-term inhalation NOAELs (i.e., 100%), a long-term inhalation NOAEL of 26 mg/kg-day can be derived from the chronic dietary NOAEL. This is consistent with the approach taken for developing inhalation NOAELs for imazapic and sulfometuron methyl.

Target MOE. The target MOE for diflufenzopyr for the non-dietary NOAELs is 100.

Cancer Dose-response Value. The USEPA has not developed a CSF for diflufenzopyr. In accordance with the *1996 Proposed Guidelines for Carcinogen Risk Assessment* (USEPA 1996), diflufenzopyr was classified as "Not Likely" to be a human carcinogen. This classification is based on the lack of evidence of carcinogenicity in mice and rats when tested at doses that were judged to be adequate to assess carcinogenicity.

Diquat

Table B-3 summarizes the dose-response values for diquat dibromide.

Dose-response Values for Dietary Exposures

Acute Dietary PAD. The USEPA has developed an acute PAD of 0.75 mg/kg-day based on an acute neurotoxicity study (MRID No. 42666801). Diquat dibromide was administered to 10 Alpk:ApfSD rats per sex per group via gavage at single dose levels of 0, 25, 75, or 150 mg/kg. The systemic NOAEL is 75 mg/kg, based on clinical signs and decreased body-weight gains at the systemic LOAEL of 150 mg/kg. The UF for deriving a human dose-response value is 100 (10 to account for interspecies differences, and 10 to account for intraspecies differences). Therefore, the acute RfD is 0.75 mg/kg-day (75 mg/kg-day / 100). The acute PAD was calculated by dividing the RfD by the FQPA SF. The USEPA has determined that the FQPA SF for diquat is 1, indicating that children are unlikely to face higher risks. Therefore, the acute PAD is the same as the acute RfD of 0.75 mg/kg-day (USEPA 2001f).

Chronic Dietary PAD. The USEPA has developed a chronic dietary PAD for all populations of 0.005 mg/kg-day. This value was based on a NOAEL of 0.5 mg/kg-day derived from a 52-week dog feeding study (MRID No. 41730301). The dose levels were 0, 0.5, 2.5, and 12.5 mg/kg-day. The LOAEL of 2.5 mg/kg-day was based on cataracts in females and decreased weights of the adrenals and epididymides in males. A chronic PAD was calculated by dividing the chronic NOAEL by an UF of 100 (0.5 mg/kg-day / 100 = 0.005 mg/kg-day). The HED Committee determined that an UF of 100 is adequate for the protection of infants and children from exposure to diquat dibromide. Therefore, because the FQPA SF is 1, the chronic PAD is 0.005 mg/kg-day (USEPA 2001f).

Dose-response Values for Non-dietary Exposures

Oral NOAELs. The USEPA has derived separate short- and intermediate-term oral NOAELs for diquat dibromide (USEPA 2001f). The short-term oral NOAEL of 1 mg/kg-day is based on a developmental toxicity study in rabbits (MRID No. 41198901). Pregnant New Zealand White rabbits were administered technical grade diquat via gavage at dose levels of 0, 1, 3, and 10 mg/kg-day from gestation days 7 through 19. The maternal toxicity NOAEL was 1 mg/kg-day, based on maternal body-weight loss and decreased food consumption at the LOAEL of 3 mg/kg-day (USEPA 2001f).

The intermediate-term oral NOAEL of 0.5 mg/kg-day is based on a chronic oral toxicity study in dogs (MRID No. 41730301), which is the same study that forms the basis for the chronic dietary PAD. The NOAEL of 0.5 mg/kg-day is based on unilateral cataracts in females and decreased adrenal and epididymides weights in males at the LOAEL of 2.5 mg/kg-day (USEPA 2001f).

Dermal NOAELs. The USEPA identified a short-term dermal NOAEL of 1 mg/kg-day based on a developmental toxicity study in rabbits (MRID No. 41198901). This is the same study on which the short-term oral NOAEL is based. In order to use this NOAEL to evaluate dermal exposure, the USEPA recommends using a dermal absorption factor of 4.1%. This value is from a dermal penetration study in rats, based on

exposure pattern and duration of exposure (MRID No. 41238701). Following 24 hours of exposure, dose levels of 0.05, 0.5, and 5 mg diquat cation/rat resulted in 2.3%, 2.1%, and 3.3% absorption, respectively. Based on these findings, the dermal absorption of diquat dibromide through intact rat skin is considered very low (USEPA 2001f).

The USEPA has identified an intermediate- and long-term dermal NOAEL of 0.5 mg/kg-day based on a chronic oral toxicity study in dogs (MRID No. 41730301). This is the same study on which the intermediate-term oral NOAEL is based. The DAF of 4.1% should be used with this NOAEL as well (USEPA 2001f).

Inhalation NOAELs. The USEPA has developed an inhalation NOAEL of 0.024 mg/kg-day for all exposure durations (short-, intermediate-, and long-term). This value is based on a subchronic 21-day inhalation study in rats (MRID No. 40301701), where male and female Fischer 344 rats were exposed via inhalation to respirable aerosols of diquat at dose levels of 0, 0.49, 1.1, and 3.8 ug/L for 3 weeks. A subsequent study (MRID No. 40640801), in which male and female Fischer 344 rats were exposed via inhalation to respirable aerosols of diquat at dose levels of 0 and 0.1 μg/L for 3 weeks, was performed to determine a NOAEL. The NOAEL of 0.024 mg/kg-day (converted from 0.1 μg/L) is based on increased lung weights and microscopic lesions in the lungs at the LOAEL of 0.117 mg/kg-day (0.49 μg/L; USEPA 2001f).

Target MOE. A target MOE of 100 is adequate to ensure protection from occupational and residential exposures to diquat dibromide by dermal and inhalation routes (USEPA 1997b). This is based on the lack of increased sensitivity to fetuses as compared to maternal animals in developmental and multigenerational reproduction toxicity studies.

Cancer Dose-response Value. The USEPA has not developed a CSF for diquat dibromide (USEPA 2001f). The carcinogenic potential of diquat dibromide was evaluated by the HDT RfD Peer Review Committee on March 31, 1994. The Committee classified diquat dibromide as a Group E carcinogen (evidence of noncarcinogenicity for humans) based on a lack of evidence of carcinogenicity in studies with two species, rat and mouse.

Fluridone

Table B-3 summarizes the dose-response values for fluridone.

Dose-response Values for Dietary Exposures

Acute Dietary PAD. The USEPA did not provide an acute RfD or PAD for fluridone (USEPA 2003a). The rationale for this was not provided in the USEPA memorandum.

Chronic Dietary PAD. The USEPA's Office of Pesticides has not developed a chronic dietary RfD or PAD for this herbicide (USEPA 2003a). However, the USEPA's IRIS database lists an RfD of 0.08 mg/kg-day (USEPA 2003c), which is used in this HHRA to evaluate dietary risks. This value was based on a NOAEL of 8 mg/kg-day derived from a combined chronic feeding/carcinogenicity study (MRID Nos. 00103251, 00103305) in Fischer rats. In this study, fluridone was administered continuously in the diet to rats (75/sex/group) at dose levels of 0, 8, 25, or 81 mg/kg-day for 2 years (60/sex/group) or for 52 weeks (15/sex/group). The LOAEL for this study is 25 mg/kg-day based on glomerulonephritis, atrophic testes, eye keratitis, decreased BW and organ weights. The RfD was calculated by dividing the NOAEL by a UF of 100 (10 for interspecies variation and 10 for intraspecies variation).

Dose-response Values for Non-dietary Exposures

Oral NOAELs. The USEPA has developed a short-term and intermediate-term oral NOAEL for fluridone of 25 mg/kg-day from a 90-day rat feeding study (USEPA 2003a). The USEPA does not provide additional detail on these NOAELs (USEPA 2003a).

Dermal NOAELs. The USEPA has developed separate short-term dermal NOAELs for children and adults. The short-term dermal NOAEL of 25 mg/kg-day for children is based on the same 90-day rat feeding study as the short-term and intermediate-term oral NOAEL for children (USEPA 2003a). However, the short-term dermal NOAEL of 125 mg/kg-day for workers and other adults is based on an oral developmental toxicity study in rabbits. In the developmental toxicity study, rabbits were exposed to 0, 125, 300, or 750 mg/kg-day of fluridone during gestation (MRID No. 00103302 [USEPA 2002a], MRID No. 00263157 [USEPA 2003a]). Effects, including maternal weight loss and abortion, were noted at the 300 mg/kg-day dose level.

The maternal NOAEL is 125 mg/kg-day. The developmental NOAEL is 125 mg/kg-day since fetal resorptions occurred in the 300 mg/kg-day dose group (USEPA 1988 *cited in* MA DEM/MA DEP 2003, USEPA 2002a).

The intermediate-term dermal NOAEL for all age groups of 25 mg/kg-day is based on the same 90-day rat feeding study as the short-term and intermediate-term oral NOAEL for children. The USEPA has not developed a long-term dermal NOAEL (USEPA 2003a). However, the long-term dietary NOAEL of 8 mg/kg-day from the combined chronic rat feeding/carcinogenicity study on which the USEPA's chronic RfD is based can be used with a DAF to address long-term dermal toxicity.

The dermal NOAELs should be used with a DAF of 40% since it is based on oral toxicological endpoints. An absorption factor of 40% was derived by dividing a maternal oral LOAEL of 300 mg/kg-day (rabbit developmental study; MRID No. 00103302 [USEPA 2002a], MRID No. 00263157 [USEPA 2003a]) by the dermal NOAEL of 768 mg/kg-day from a 21-day dermal toxicity study in rabbits (MRID No. 00070933). No systemic effects were noted at any dose, and 768 mg/kg-day was the HDT. The absorption factor should be considered an upper-bound estimate.

Inhalation NOAELs. The USEPA has developed a short-term inhalation NOAEL for all age groups of 125 mg/kg-day, which is based on the same oral rabbit developmental toxicity study as the short-term dermal NOAEL for adults discussed above (USEPA 2003a).

The intermediate-term inhalation NOAEL for all age groups of 25 mg/kg-day is based on the same 90-day rat feeding study as the short-term and intermediate-term oral NOAEL for children. The USEPA has not developed a long-term inhalation NOAEL (USEPA 2003a). However, the long-term dietary NOAEL of 8 mg/kg-day from the combined chronic rat feeding/carcinogenicity study on which the USEPA's chronic RfD is based can be used with an IAF to address long-term inhalation toxicity.

The inhalation NOAELS should assume 100% absorption by the inhalation route; therefore, no adjustment to the oral NOAELs is required (USEPA 2003a).

Target MOE. The target MOE for all NOAELs is 100.

Cancer dose-Response Value. The USEPA has not developed a CSF for fluridone. In accordance with the 1986 Carcinogen Risk Assessment, fluridone was classified as a Group E carcinogen (no evidence of carcinogenicity) based on lack of evidence for carcinogenicity in two acceptable rodent (mice and rats) carcinogenicity studies (USEPA 1997c).

Imazapic

Table B-3 summarizes the dose-response values for imazapic.

Dose-response Values for Dietary Exposures

Acute Dietary PAD. An acute RfD or PAD was not established, since an appropriate endpoint attributable to a single dose was not available. No developmental toxicity was seen in rats or rabbits and maternal toxicity in rabbits occurred on days 7 through 19 of gestation (USEPA 2001a).

Chronic Dietary PAD. The USEPA has developed a chronic dietary PAD of 0.5 mg/kg-day. This value was based on a LOAEL of 137 mg/kg-day derived from a 1-year dietary toxicity study in dogs (MRID No. 42711421). In this study, imazapic was administered via the diet to groups of six beagle dogs per sex per dose, at concentrations of 0, 5,000, 20,000, or 40,000 ppm (equivalent to mean achieved dosages of 137, 501, and 1,141 mg/kg-day in males and 180, 534, and 1,092 mg/kg-day in females), respectively. The LOAEL in this study was 137 mg/kg-day in males and 180 mg/kg-day in females based on minimal degeneration and/or necrosis of the skeletal muscle of the thigh and/or abdomen in both male and, to a lesser extent, female dogs. This histological finding was associated with minimal lymphocyte and macrophage infiltration. Minimal infiltration was also observed in the diaphragm of one dog of each sex. Decreased serum creatinine was also present in females. A NOAEL was not established in this study.

The chronic RfD was calculated by dividing the LOAEL of 137 mg/kg-day by an UF of 300, resulting in a value of 0.5 mg/kg-day. The UF of 300 consists of factors of 10 for interspecies differences, 10 for intraspecies variations, and 3 for the use of a LOAEL rather than a NOAEL for this endpoint. The use of a 3-fold UF, rather than a 10-fold factor, was due to the minimal severity of the skeletal muscle degeneration and/or necrosis and to the relatively constant severity across doses (USEPA 2001a). The USEPA has not developed an FQPA SF for this chemical. However,

based on the mild toxicological effects at the LOAEL and the lack of increased risk to children versus adults, it is assumed that the FQPA SF is 1 and that the chronic PAD is the same as the chronic RfD of 0.5 mg/kg-day.

Dose-response Values for Non-dietary Exposures

Oral NOAELs. The USEPA has derived a short-term (1 to 7 days) and intermediate-term (7 days to several months) oral NOAEL for imazapic of 350 mg/kg-day (USEPA 2001a). This value was based on a rabbit developmental toxicity study (MRID No. 42711423) in which groups of 20 impregnated New Zealand White rabbits were administered imazapic during gestation days 7 through 19 at daily doses of 0, 175, 350, 500, or 700 mg/kg-day. The LOAEL for maternal toxicity is 500 mg/kg-day based on decreased BW gain and food consumption during the dosing period. The NOAEL for maternal toxicity is 350 mg/kg-day.

Although there was an increase in fetal incidences of rudimentary ribs, it was determined that this effect was not related to treatment. The NOAEL for developmental toxicity is 500 mg/kg-day, which is higher than the NOAEL for maternal toxicity. Therefore, the short-term and intermediate-term oral NOAEL was determined to be 350 mg/kg-day (USEPA 2001a).

Dermal NOAELs. The USEPA has not derived short- and intermediate-term dermal NOAELs, since no effects were noted in a dermal toxicity study in rabbits. The 21-day dermal toxicity study in rabbits was conducted (MRID No. 42711420) by applying imazapic to the clipped backs of New Zealand albino rabbits at targeted doses of 0, 250, 500, or 1,000 mg/kg-day for 6 hours per day, 5 days per week, for 3 weeks. There were no systemic or developmental effects observed up to the limit dose (1,000 mg/kg-day), therefore a toxicity endpoint was not selected from this study (USEPA 2001a).

The USEPA developed a long-term dermal LOAEL of 137 mg/kg-day that is used with a DAF of 50%. The LOAEL of 137 mg/kg-day is based on a 1-year dog feeding study (which is also the basis for the chronic PAD) and considers an increased incidence of minimal degeneration and/or necrosis of the skeletal muscle of the thigh and/or abdomen. Since a NOAEL was not established in the 1-year dog feeding study, the LOAEL of 137 mg/kg-day was selected for the long-term dermal exposure scenario. This value should be used with a DAF of 50%. The USEPA derived the DAF by dividing the oral maternal LOAEL of 500 mg/kg-day (rabbit developmental study; MRID No. 42711423) by the dermal NOAEL of 1,000 mg/kg-day in the 21-day dermal toxicity study in rabbits (MRID No. 42711420). The upper bound estimated percent dermal absorption was 50%. Additionally, a target MOE of 300 is required for this scenario because of the use of a LOAEL rather than a NOAEL (USEPA 2001a).

Inhalation NOAELs. Due to the lack of appropriate inhalation studies, the USEPA has selected oral NOAELs to be used for inhalation exposure risk assessments with appropriate absorption factors. The IAF is 100%, therefore no adjustment is needed for the oral NOAELs. For evaluating short- and intermediate-term inhalation exposures, the USEPA recommends the use of the maternal systemic toxicity NOAEL of 350 mg/kg-day based on a developmental toxicity study in rabbits. A target MOE of 100 is used for this scenario (USEPA 2001a).

For evaluating long-term inhalation exposures, the USEPA recommends the use of the systemic oral toxicity LOAEL of 137 mg/kg-day based on a 1-year oral toxicity study in dogs. A target MOE of 300 is required for this exposure scenario because of the use of a LOAEL rather than a NOAEL (USEPA 2001a).

Target MOE. A target MOE of 100 is used for the oral NOAELs, and short- and intermediate-term inhalation NOAELs. A target MOE of 300 is used for the long-term dermal and long-term inhalation NOAELs because these values are based on LOAELs rather than NOAELs.

Cancer Dose-response Value. In accordance with the 1986 Carcinogen Risk Assessment, imazapic was classified as a Group E carcinogen (no evidence of carcinogenicity) based on lack of evidence for carcinogenicity in two acceptable rodent (mice and rats) carcinogenicity studies.

Sulfometuron Methyl

The USEPA has developed various dose-response values specific for different toxicological endpoints (USEPA 2003b). Table B-3 summarizes the dose-response values for sulfometuron methyl.

Dose-response Values for Dietary Exposures

Acute Dietary PAD. An appropriate endpoint attributable to a single dose of sulfometuron methyl was not available in the toxicology data base. Therefore, an acute RfD or PAD was not established (USEPA 2003b).

Chronic Dietary PAD. The USEPA has developed a chronic RfD of 0.05 mg/kg-day. This value was based on a NOAEL of 5 mg/kg-day derived from a 1-year study in dogs (MRID No. 00129051). The LOAEL for this study was 25 mg/kg-day based on mild hemolytic anemia. A chronic RfD was calculated by dividing the chronic NOAEL of 5 mg/kg-day by a UF of 100 (10 for interspecies variation and 10 for intraspecies variation). The USEPA has not developed an FQPA SF for this chemical. However, based on the mild toxicological effects at the LOAEL and because children would not be expected to be more prone to this effect than adults, it is assumed that the FQPA SF is 1 and that the chronic PAD is the same as the chronic RfD of 0.05 mg/kg-day.

Dose-response Values for Non-dietary Exposures

Oral NOAELs. The USEPA has developed short-term and intermediate-term oral NOAELs of 5 mg/kg-day. This value was based on a 1-year study in dogs (MRID No. 00129051). The LOAEL for this study was 25 mg/kg-day based on mild hemolytic anemia (USEPA 2003b).

Dermal NOAELs. No systemic or dermal toxicity was seen following repeated dermal applications of up to 2,000 mg/kg-day to rabbits. There were no concerns for developmental or reproductive toxicity; therefore, quantification of dermal risk is not required (USEPA 2003b).

Inhalation NOAELs. The USEPA has developed an inhalation NOAEL for all exposure durations of 5 mg/kg-day. This value was based on the same 1-year study in dogs (MRID No. 00129051) on which the RfD and oral NOAELs were based. The LOAEL for this study was 25 mg/kg-day based on mild hemolytic anemia (USEPA 2003b). In the absence of chemical-specific information, the USEPA (2003b) recommends using 100% absorption for route-to-route extrapolation.

Target MOE. The target MOE for all NOAELs is 100.

Cancer Dose-response Value. The USEPA (2003b) states that the carcinogenicity of sulfometuron methyl is not yet evaluated. However, no carcinogenic effects have been detected in either rats or mice exposed to sulfometuron methyl (USEPA 1990 *cited in* Extoxnet 1996b). Therefore, it is reasonable to assume that sulfometuron methyl would not be classified as a likely carcinogen.

Inert Ingredients

In addition to the active ingredients, most herbicides also contain inert ingredients (i.e., those substances included in the formulation that are not the active ingredients) that have various functions such as diluents, binders, dispersants, carriers, stabilizers, neutralizers, antifoamers, and buffers.

The USEPA categorizes inert ingredients into four lists (54 FR 48314):

- List 1 – Inert ingredients of toxicological concern. Any product containing a List 1 ingredient must include the label statement, "this product contains the toxic inert ingredient (name of inert)."
- List 2 – Inerts of unknown toxicity/high priority for testing inerts.
- List 3 – Inerts of unknown toxicity. Inert ingredients on this list have not yet been determined to be of known potential toxicological concern nor have they been determined to be of minimal concern. These substances will continue to be evaluated to determine if they merit reclassification to List 1, 2, or 4.
- List 4 – Inerts of minimal concern. List 4 is subdivided into List 4A (minimal risk inert ingredients) and List 4B (inerts that have sufficient data to substantiate they can be used safely in pesticide products).

BLM scientists received clearance from USEPA to review Confidential Business Information (CBI) on inert compounds identified in products containing the six active ingredients evaluated in this risk assessment. The information received listed the inert ingredients, their chemical abstract number, supplier, USEPA registration number, percentage of the formulation and purpose in the formulation. Because this information is confidential, this information, including the name of the ingredients may not be disclosed.

The USEPA has a listing of regulated inert ingredients at http://www.epa.gov/opprd001/inerts/index.html. This listing categorizes inert ingredients into the four categories listed above. The number of inert ingredients present in the formulations containing the six active ingredients evaluated in this risk assessment are shown below:

- List 1 – no inerts found
- List 2 – no inerts found
- List 3 – 6 inerts found
- List 4 – 29 inerts found

Therefore, the majority of the inerts are of minimal risk. A few are in the category of unknown toxicity.

Exposure Assessment

The purpose of the exposure assessment is to predict the magnitude and frequency of potential human exposure to the herbicides under consideration in the HHRA. The first step in the exposure assessment process is to identify potential exposure pathways that are appropriate for planned BLM use of the herbicides. This step also involves identifying potential receptors (i.e., people who may contact the impacted environmental media of interest) and the exposure routes by which environmental media may be contacted (i.e., ingestion, dermal contact, inhalation). Those potential exposure pathways that are judged to be complete are evaluated quantitatively in the risk assessment. According to the USEPA (1989), for an exposure pathway to be complete, the following conditions must exist:

- A source and mechanism of chemical release to the environment
- An environmental transport medium (e.g., air, water, soil)
- A point of potential receptor contact with the medium
- A human exposure route at the contact point (e.g., inhalation, ingestion, dermal contact)

Where one or more of these conditions is not met, an exposure pathway is not complete.

The second step in the exposure assessment process involves quantifying exposure for each of the receptors and exposure pathways. To estimate the potential risk to human health that may be posed by the planned herbicide use, it is fist necessary to estimate the potential exposure dose of each herbicide for each receptor. The exposure dose of each herbicide is estimated for each receptor via each exposure route/pathway by which the receptor is assumed to be exposed. Exposure dose equations combine the estimates of herbicide concentration in the environmental medium of interest with assumptions regarding the type and magnitude of each receptor's potential exposure to provide a numerical estimate of the exposure dose. The exposure dose is defined as the amount of herbicide taken into the receptor and is expressed in units of milligrams of herbicide per kilogram of BW per day (mg/kg-day). The exposure doses are combined with the dose-response values to estimate potential risks for each receptor.

To understand how humans may be exposed to herbicides as a result of the BLM vegetation treatment program, it is necessary to understand herbicide use within the BLM. Within the BLM vegetation treatment program, public lands are classified into various land programs. Within each program, aerial-, ground- or boat-based applications may be used. Various application vehicles (airplane, helicopter, all-terrain vehicle [ATV], boat, horse, or human) can be used for each application type, and for each vehicle, there are different application methods, including deposition (from an airplane or helicopter), boom/broadcast, and spot applications. Similarly, there are different BLM job descriptions associated with each application method. It is assumed that occupational receptors may be incidentally exposed to the herbicide used through dermal contact and inhalation exposure pathways.

These potential exposures are evaluated for each herbicide under routine use, and it is assumed that use is consistent with label directions. In addition, an accidental spill scenario, assuming an herbicide spill to worker skin, is evaluated for the occupational receptors.

Members of the public may also be incidentally exposed to herbicides used on public lands. Such receptors may include hikers, hunters, berry pickers, swimmers, anglers, area residents, and Native Americans using natural resources on public lands. Exposures to both spray drift and direct spray/accidental spill scenarios are evaluated.

Overview of the BLM Vegetation Treatment Program

This section identifies the land programs, application types, application vehicles, and application methods for herbicide use in the BLM vegetation treatment program.

Land Programs

The BLM vegetation treatment program covers six land types or programs:

- Rangeland

- Public Domain Forestland
- Energy and Mineral Sites
- Rights-of-way (ROW)
- Recreation and Cultural Sites
- Aquatic Sites

Herbicides are used in rangeland improvement and silvicultural practice to improve the potential for success of desired vegetation by reducing competition for light, moisture, and soil nutrients with less desirable plant species. Herbicides are used to manage or restrict noxious plant species and to suppress vegetation that interferes with manmade structures or transportation corridors.

Weed and vegetation management programs are developed to address the occurrence of noxious, invasive, and undesirable species which have a negative impact on native vegetation, human activities, and domestic livestock. Examples of plant species of concern include, downy brome, giant salvinia, leafy spurge, purple loosestrife, Russian and spotted knapweed, tamarisk, and yellow star thistle. The noxious weed and poisonous plant control program is included as part of the vegetation treatment methodology that the BLM uses to maintain the areas under its jurisdiction. The BLM uses herbicides, a component in an integrated weed management program, as one of the options available in its noxious weed management program and uses them in varying degrees in all land treatment categories. Herbicide use under the six land programs is discussed below.

Rangeland

Rangeland vegetation treatment operations provide forage for domestic livestock and wildlife by removing undesirable competing plant species and preparing seedbeds for desirable plants. Approximately, 89% of the herbicide treated acreage in the BLM vegetation treatment program falls in the rangeland improvement category.

Of the herbicide active ingredients being evaluated, imazapic and diflufenzopyr + dicamba are registered for use under rangeland situations. Proposed application methods include the following vehicles and methods: airplane, helicopter, truck-mounted sprayer (boom/broadcast or spot applications), ATV (boom/broadcast or spot applications), horseback (spot applications), and backpack (spot applications).

Public Domain Forestland

Public domain forestland vegetation treatment operations, designed to ensure the establishment and healthy growth of timber crop species, are one of the BLM's least extensive programs for herbicide treatment. These operations include site preparation, plantation, maintenance, conifer release, pre-commercial thinning, and non-commercial tree removal. Site preparation treatments prepare newly harvested or inadequately stocked areas for planting of new tree crops. Herbicides used in site preparation reduce vegetation that would compete with conifers. In the brown-and-burn method of site preparation, herbicides are used to dry the vegetation, to be burned several months later. Herbicides are used in plantations some time after planting to promote the dominance and growth of already established conifers (release). Pre-commercial thinning reduces competition among conifers, thereby improving the growth rate of desirable crop trees. Non-commercial tree removal is used to eliminate dwarf mistletoe infested host trees. These latter two silvicultural practices primarily use manual applications methods. Herbicide uses in public domain forests constitute less than 4% of the vegetation treatment operations in the BLM program.

Imazapic and sulfometuron methyl are proposed for use on public domain forestland. Proposed application methods include the following vehicles and methods: airplane, helicopter, truck (boom/broadcast and spot applications), ATV (boom/broadcast or spot applications), horseback (spot applications), and backpack (spot applications), with the exception that sulfometuron methyl would not be applied via airplane.

Energy and Minerals Sites

Vegetation treatments in energy and mineral sites include the preparation and regular maintenance of areas for use as fire control lines or fuel breaks, or the reduction of vegetation species that could pose a hazard to fire control operations. More than 50% of the vegetation treatment programs for energy and minerals sites are herbicide applications.

Of the herbicide active ingredients being evaluated, imazapic, diflufenzopyr + dicamba, and sulfometuron methyl are proposed for use under the conditions described on energy and mineral sites. Proposed application methods include the following vehicles and methods: airplane, helicopter, truck (boom/broadcast or spot applications), ATV (boom/broadcast or spot applications), horseback (spot applications), and

backpack (spot applications). However, sulfometuron methyl would not be applied via airplane, and diflufenzopyr + dicamba would not be applied via airplane or helicopter.

Rights-of-way

Rights-of-way treatments include roadside maintenance and maintenance of power transmission lines, waterways, and railroad corridors. In roadside maintenance, vegetation is removed or reduced from ditches and shoulders to prevent brush encroachment into driving lanes, to maintain visibility on curves for the safety of vehicle operators, to permit drainage structures to function as intended, and to facilitate maintenance operations. Herbicides have been used in nearly 50% of the BLM's roadside vegetation maintenance programs.

Imazapic, diflufenzopyr + dicamba, and sulfometuron methyl are proposed for use on ROW sites. Proposed application methods include the following vehicles and methods: airplane, helicopter, truck (boom/broadcast or spot application), ATV (boom/broadcast or spot applications), horseback (spot applications), and backpack (spot applications). However, sulfometuron methyl would not be applied via airplane, and diflufenzopyr would not be applied via airplane or helicopter.

Recreation and Cultural Sites

Recreation and cultural site maintenance operations provide for the safe and efficient use of BLM facilities and recreation sites and for permittee/grantee uses of public amenities, such as, ski runs, waterways, and utility terminals. Vegetation treatments are made for the general maintenance and visual appearance of the areas and to reduce potential threats to the site's plants and wildlife, as well as, visitor's health and welfare. The site maintenance program includes the noxious weed and poisonous plant program. Vegetation treatments in these areas are also for fire management.

The BLM uses herbicides on approximately one-third of the total recreation site acreage identified as needing regular treatment operations. Imazapic, diflufenzopyr + dicamba, and sulfometuron methyl are proposed for use on recreation and cultural sites. Proposed application methods include the following vehicles and methods: airplane, helicopter, truck (boom/broadcast or spot application), ATV (boom/broadcast or spot applications), horseback (spot applications), and backpack (spot applications). However, sulfometuron methyl would not be applied via airplane, and diflufenzopyr + dicamba would not be applied via airplane or helicopter.

Aquatic Sites

Aquatic vegetation management involves addressing the vegetation in a variety of situations ranging from rivers, streams, and canals to ponds, lakes, and water holdings. Impacts addressed through the management of aquatic vegetation include, but are not limited to, the following: altering the flow of water, displacement of native/desirable vegetation, and reduction in recreational activities.

Fluridone and diquat are proposed for use on aquatic and riparian sites. Proposed application methods include the following vehicles and methods: airplane, helicopter, boat (boom/broadcast or spot applications), truck (boom/broadcast or spot applications), ATV (boom/broadcast or spot applications), horseback (spot applications), and backpack (spot applications). However, fluridone would not be applied via spot applications using a boat.

Application Methods

The BLM conducts pretreatment surveys in accordance with BLM Handbook H-9011-1 (*Chemical Pest Control*) before making a decision to use herbicides on a specific land area. The herbicides can be applied by a number of different methods, and the selected technique is dependent upon a number of variables, including the following:

- Treatment objective (removal or reduction)
- Accessibility, topography, and size of the treatment area
- Characteristics of the target species and the desired vegetation
- Location of sensitive areas in the immediate vicinity (potential environmental impacts)
- Anticipated costs and equipment limitations
- Meteorological and vegetative conditions of the treatment area at the time of treatment

Herbicide applications are scheduled and designed such that there are minimal potential impact on non-target plants and animals, while remaining consistent with the objectives of the vegetation treatment program. Herbicides are applied either from the air or on the

ground. The herbicide formulations may be in a liquid or granular form, depending upon resources and program objectives. Aerial methods employ boom-mounted nozzles for liquid formulations or rotary broadcasters for granular formulations, carried by helicopters or airplanes. Ground application methods include vehicle- and boat-mounted, backpack, and horseback application techniques. Vehicle- and boat-mounted application systems use fixed-boom or hand-held spray nozzles mounted on trucks or ATVs. Backpack systems use a pressurized sprayer to apply an herbicide as a broadcast spray directly to one or a group of individual plants. Aerial, ground, and aquatic application methods are discussed later in this section.

Aerial Application Methods

Aerial application methods can be conducted using either airplanes (fixed-wing aircraft) or helicopters (rotary-wing aircraft). Historically, the BLM has used aerial application in more than 50% of its herbicide treatment programs. Helicopters have been used more than 60% of the time on rangeland projects because the many treatment units are far apart and are often small and irregularly shaped.

The size and type of these aircraft may vary, but the equipment used to apply the herbicides must meet specific guidelines. Contractor-operated helicopters or fixed-wing aircraft are equipped with an herbicide tank or bin (depending on whether the herbicide is a liquid or granular formulation). For aerial spraying, the aircraft is equipped with cylindrical jet-producing nozzles no less than 1/8-inch diameter. The nozzles are directed with the slipstream, at a maximum of 45 degrees downward for fixed-wing, or up to 75 degrees downward for helicopter application, depending on the flight speed. Nozzle size and pressure are designed to produce droplets with a diameter of 200 to 400 microns. For fixed-wing aircraft, the spray boom is typically ¾ of the wingspan, and for helicopters, the spray boom is often ¾ of the rotor diameter. All spray systems must have a positive liquid shut-off device that ensures that no herbicide continues to drip from the boom once the pilot has completed a swath (i.e., specific spray path). The nozzles are spaced to produce a uniform pattern for the length of the boom.

Using helicopters for herbicide application is often more expensive than using fixed-wing aircraft, but helicopters offer greater versatility. Helicopters are well adapted to areas dominated by irregular terrain and long, narrow, and irregularly shaped land patterns, a common characteristic of public lands. Various helicopter aircraft types are used, including, Bell, Sikorsky, and Hiller models. These helicopters must be capable of accommodating the spray equipment and the herbicide tank or bin and of maintaining an air speed of 40 to 50 miles per hour at a height of 30 to 45 feet above the vegetation (depending upon the desired application rate [AR]), and they must meet BLM safety performance standards.

Fixed-wing aircraft include the typical, small "cropduster" type aircraft. Fixed-wing aircraft are best suited for smoother terrain and larger tracts of land where abrupt turning is not required. Because the fixed-wing aircraft spraying operations are used for treating larger land areas, the price per acre is generally lower than for helicopter spraying. Aircraft capability requirements for fixed-wing aircraft are similar to helicopter requirements, except that an air speed of 100 to 120 miles per hour is necessary, with spraying heights of 10 to 40 feet generally used to produce the desired ARs.

Batch trucks are an integral part of any aerial application operation. They serve as mixing tanks for preparing the correct proportions of herbicide and carrier, and they move with the operation when different landing areas are required.

The number of workers involved in a typical aerial spray project varies according to the type of activity. A small operation may require up to six individuals, while a complex operation may require as many as 20 to 35 workers. An aerial operations crew for range management, noxious weed management, and ROW maintenance usually consists of five to eight individuals. Typically, personnel on a large project include a pilot, a mixer/loader, a contracting officer's representative, an observer-inspector, a one-to six-member flagging crew, one or two law enforcement officers, one or two water monitors, and one or two laborers. Optional personnel include an air operations officer, a radio technician, a weather monitor, and a recorder. Workers evaluated in the HHRA for aerial applications include a pilot and a mixer/loader, as these are the receptors most likely to be exposed to herbicides. Other personnel are expected to have less or similar herbicide exposure.

Ground Application Methods

The BLM does not use ground application extensively. In vegetation treatment projects, ground herbicide applications normally constitute about 45% of the total area that the BLM treats with herbicide. There are two

types of ground application methods, including, human application methods (backpack and horseback) and vehicle application which includes, ATV-based application methods (spot-treatment or boom/broadcast treatment), and truck-mounted application methods (spot-treatment or boom/broadcast treatment). These are described in greater detail below.

Human Application Methods. Humans using either backpack or horseback application methods may apply herbicides. The backpack method requires the use of a backpack spray tank for carrying the herbicide with a handgun applicator with a single nozzle for herbicide application. These techniques are best adapted for very small scale spraying in isolated spots and those areas that are not accessible by vehicle. They are primarily used for spot treatments around signposts, spraying competing trees in public domain forestland, delineators, power poles, scattered noxious weeds, and other areas that require selective spraying.

Backpack treatment is the predominant ground-based method for silviculture and range management. The principal hand application techniques are injection and stump treatment. Injection involves applying an herbicide with the hand-held container or injector through slits cut into the stems of target plants. Individual stem treatment by the injection method is also used for thinning crop trees or removing the undesirable trees. Stump treatment entails directly applying liquid herbicide to the cut stump of the target plant to inhibit sprouting. An herbicide can be applied by dabbing or painting the exposed cambium of a stump or using a squeeze bottle on a freshly cut cambium surface. Along with liquid formulations, certain active ingredients are formulated in a granular form that allows for direct application to the soil surface. Pressurized backpack treatment operations typically involve a supervisor (who may also function as a mixer/loader), an inspector, a monitor, and 2 to 12 crewmembers. The receptor evaluated in this risk assessment is a combined applicator/mixer/loader.

Vehicle Application Methods. Herbicide treatments may use ground-based spray applications using either a truck or an ATV. Vehicular application is made using a boom with several spray nozzles (boom/broadcast treatment) or a handgun with a single nozzle (spot treatment). Ground vehicle spray equipment can be mounted on ATVs or trucks. Because of its small size and agility, the ATV can be adapted to many different situations.

The boom spray equipment used for vehicle operations is designed to spray wide strips of land where the vegetation does not normally exceed 18 inches in height and the terrain is generally smooth and free of deep gullies. Ground spraying from vehicles occurs along highway ROW, energy and mineral sites, public domain forestlands, and rangeland sites.

Ground spraying operations are also conducted from vehicles using spot-gun spraying. The spot-gun technique is best adapted for spraying small, scattered plots. It may also be used in spraying signposts and delineators within highway ROW and around wooden power lines as a means of reducing fire hazards within power line ROW. This technique is also used to treat scattered noxious weed vegetation, but it is limited to those areas that are accessible by vehicles.

Rights-of-way maintenance projects frequently use vehicle-mounted application techniques. A truck with a mixing/holding tank uses a front mounted spray boom or a hand-held pressurized nozzle to treat roadside vegetation on varying slopes. However, using this equipment for off-road ROW projects is limited to gentle slopes (less than 20%) and open terrain. Workers typically include a driver/mixer/loader and an applicator. Therefore, receptors evaluated in this HHRA include an applicator, a mixer/loader, and a combined applicator/mixer/loader.

Aquatic Application Methods

Aquatic vegetation, at moderate growth levels, is useful because it produces oxygen, food, and cover for fish and other aquatic organisms. However, in overabundance, aquatic plants can become weedy, crowd out desirable plants, adversely affect other aquatic life, and interfere with human uses of water.

Aquatic Application Techniques. There are four zones in a body of water that may be treated for the management of aquatic weeds: water surface, total water volume, bottom 1 to 3 feet of water, and the bottom soil surface. When working in the water surface zone, generally, only a fourth to a third of the surface area (SA) should be treated at a time. Applications are made to floating or emergent weeds with the spray mixture being applied directly to the plants.

The whole body of water is treated when working in this particular zone. Treatments are usually made to 1/4 to 1/3 of the total water volume at a time. Applications can be made through the metering or injecting of the herbicide into the water from booms trailing behind the

boat or as a spray over the water surface. Applications of this type are made to submersed aquatic plants and algae.

Treating the deepest 1 to 3 feet of water is the principle behind making applications in the bottom-layer zone. Such treatments are generally made by attaching several flexible hoses at specific intervals on a rigid boom. Each hose is equipped with a nozzle and may be weighted to reach the depth desired. The length of hose and the speed of the boat carrying the application equipment also affect the depth of application. Such applications are beneficial because they apply the herbicide in a layer nearer the area where the herbicide can be taken up by the weedy species.

The final zone, bottom soil surface, refers to applications made to the bottom soil of a drained pond, lake or channel.

Aquatic Application Equipment. To treat small areas, a compressed-air sprayer with a hand-operated pump may be all that is needed. Higher-quality compressed-air sprayers with CO_2 gas for constant pressure are available but are more expensive. For larger areas, a boat-mounted pump-and-tank rig with one line may be used to treat emergent plants on a spot treat basis. A boom attached to the boat may be used when broadcast applications are made to the surface of the water. Booms with flexible hoses attached to the boom may be used to make the application below the water surface.

Applications of granules and slow-release pellets can be made either using a cyclone spreader or by hand. The granules sink to the bottom, where the chemical is slowly released in the relatively small volume of water where the new shoots are beginning to grow.

Vegetation Management – Static Water. Static water is water in ponds, lakes, or reservoirs that has little or no inflow and outflow. Floating and emersed vegetation is managed by direct foliage applications of the spray mixture by aircraft, with ground equipment—operated from the bank if the pond is small or if the weeds occur only around the margins, or from a boat—using various types of booms or hand applicators.

Submersed vegetation and algae can be managed through spray or granular applications. Spray applications can be made by aircraft, boat, or ground application equipment. Applications can be made under the water surface by injection through a hose pulled behind a boat or by a series of hoses attached to a boom that is attached to the boat. Granular herbicides may be broadcast by hand or manual spreaders over small areas. Special granule spreaders mounted on aircraft or boats are used for large-scale applications.

Vegetation Management – Flowing Water. Aquatic vegetation in flowing water is difficult to manage. Floating and emersed vegetation, when treated in flowing water, require the same treatment techniques as they do in the static water. Submersed vegetation and algae can be controlled effectively in flowing water only by continuously applying enough herbicide at a given spot to maintain the needed concentration and contact time.

Herbicide Use Parameters

The ARs are dependent on the target species, the presence and condition of non-target vegetation, the soil type, the depth to the water table, and the presence of other water sources. Tables B-4 to B-9 summarize the vegetation treatment program for each of the herbicides. Both typical and maximum ARs (in units of pounds of a.i. per acre [lb a.i./acre]) are provided for each application scenario, vehicle, and method in each land program. As can be seen in the tables, and as discussed above, not all herbicides are used for all potential applications. The ARs for fluridone depend on the type of water body (i.e., pond, stream, lake). Therefore, the highest typical and maximum ARs for fluridone were employed (highest typical is for a pond, and highest maximum is for a partial lake/reservoir).

Occupational Receptors

A receptor and the exposure pathways by which that receptor may come into contact with herbicides used in the BLM vegetation treatment program define an exposure scenario. Both routine use and accidental exposure scenarios are included in the occupational evaluation.

Routine Use Exposure Scenarios

For aerial applications, occupational receptors that may come into contact with herbicides include:

- Pilot
- Mixer/loader

For ground applications by backpack, as the operation is generally very small in scale, the occupational receptor is assumed to be an:

- Applicator/mixer/loader

For the remaining application methods (horseback; and spot and boom/broadcast methods for ATV, truck mount and boat applications), the herbicide treatment job could be large enough to support a crew, in which case the applicator may be a person different from the mixer/loader. Alternatively, the job may be small enough that the applicator and the mixer/loader are the same person. Therefore, for these application methods, the following occupational receptors are evaluated:

- Applicator
- Mixer/loader
- Applicator/mixer/loader

Exposure assumptions for the occupational receptors were derived using information from the BLM concerning proposed use of the herbicides and unit exposure (UE) information from the Pesticide Handlers Exposure Database (PHED), which is a generic database containing empirical dermal and inhalation exposure data for workers mixing, loading, or applying pesticides (USEPA 1998a).

Workers are assumed to weigh 70 kg, which is the weight recommended by the USEPA in its Standard Default Exposure Assumptions (USEPA 1991). Estimates of the number of hours per day a worker may be engaged in applying herbicides, the number of days per year the worker applies herbicides, and the years of potential exposure were provided by the BLM. The BLM also provided data regarding the number of acres treated (AT) per hour.

A description of the PHED is provided in a peer-reviewed article by Leighton and Nielsen (1995). The PHED was developed by the PHED task force, which consists of representatives from the USEPA, Health Canada, the California Department of Pesticide Regulation, and member companies of Crop Life America. To add consistency to the risk assessment process, the USEPA, in conjunction with the PHED task force, has evaluated all data within the system and developed surrogate exposure tables that contain a series of standard UE values for various exposure scenarios. The majority of the UE values used in this risk assessment have been taken from this "surrogate" table. In addition to the values presented in this table, the USEPA recommended UEs separately for aquatic applications of diquat and fluridone. Generally, UEs are expressed in units of mg/lb a.i. and equate the milligrams of a.i. absorbed by an occupational receptor to the pounds of a.i. handled in a given day or exposure scenario.

For the dermal exposure pathway for terrestrial herbicides, two sets of UEs are used assuming that worker personal protective equipment (PPE) requires gloves or does not require gloves. The Oust® (sulfometuron methyl) label does not require the use of gloves, therefore, the UEs for workers not wearing gloves were used for this herbicide. Unit exposures based on workers wearing gloves were used for the remaining terrestrial herbicides, which are Overdrive® (diflufenzopyr) and Plateau® (imazapic), because the labels for these two herbicides state that gloves must be worn when applying the herbicides.

The UEs for aquatic applications were developed for this HHRA after consultation with the USEPA (J. Evans personal communication 2003k). For aquatic use of Reward® (diquat), the USEPA recommended the use of dermal UE values (in units of mg/hr) presented in the Reregistration Eligibility Decision (RED) document for diquat (USEPA 1995). Specifically, the UEs for hydrilla control–applicator and hydrilla control–mixer were used. There are no inhalation UEs for this application. The USEPA (1995) obtained these UEs from a study evaluating worker exposure to paraquat and diquat in Florida (Wojeck et al. 1983). For aquatic use of Sonar® A.S. (fluridone), the USEPA recommended the use of UEs specific for granular application listed in PHED (USEPA 1998a). The Reward® (diquat) label requires the use of gloves. The Sonar® A.S. (fluridone) label does not discuss the use of PPE, but states that skin contact should be avoided.

Accidental Exposure Scenarios

Accidental exposures for occupational receptors could occur via spills, hose breaks on application equipment, or direct spray onto a worker. As a worst case scenario for an accidental exposure, a direct spill event on an occupational receptor is evaluated. The spill scenario evaluated by the BLM in the *Final EIS Vegetation Treatment on BLM Lands in Thirteen Western States* (1991 13-State EIS; USDI BLM 1991) assumed that 0.5 L of the formulation is spilled on a worker receptor. It is assumed that the 80% of the spill lands on clothing and 20% lands on bare skin. The penetration rate through clothing is assumed to be 30%.

Public Receptors

Public lands administered by the BLM are diverse and include rangeland, public forestland, energy and

minerals sites, ROW, and recreational and cultural sites. Lakes, ponds, and waterways may also be present on these lands. Public land is used by the public for a variety of occupational, recreational, and cultural activities. Hunters and hikers enjoy these public lands as well as anglers and swimmers. Harvesting of natural resources by the public occurs on these lands including berry picking, harvesting of fish for consumption, and the gathering of materials for Native American crafts such as basket weaving.

When herbicides are used as part of a vegetation treatment program on public lands, the BLM takes care to flag the area to be treated and to post the area with warnings about when re-entry can occur safely.

This HHRA evaluates the potential risk to public receptors using public lands treated with herbicides by developing exposure scenarios that combine potential receptors and exposure pathways to identify potential worst-case exposures to the herbicides addressed in this EIS. Two types of public use exposure scenarios are addressed:

- Potential exposure during routine use of public lands to herbicides that may have drifted outside of the area of application
- Accidental scenarios where public receptors may prematurely enter a sprayed area, be sprayed directly, or may contact water bodies that have accidentally been sprayed directly or into which an herbicide mixture has accidentally been spilled

Although all of these public scenarios are expected to occur rarely, they are nonetheless used as the basis for evaluating potential public health risks associated with herbicide use in the BLM vegetation treatment program.

Based on consideration of potential public uses of BLM lands and consistent with the 1991 13-State EIS receptors evaluated in this HHRA include the following:

- Hiker/hunter
- Berry picker - child and adult
- Angler
- Swimmer - child and adult
- Nearby Resident - child and adult
- Native American – child and adult

Although there are many different exposure scenarios and receptors that could be evaluated, these receptors cover a range of potential exposures that could occur under worst case conditions on public lands. It is assumed that these receptors could be exposed through one or more of the following exposure pathways:

- Dermal contact with spray
- Dermal contact with foliage
- Dermal contact with water while swimming
- Occasional ingestion of drinking water or incidental ingestion of water while swimming
- Ingestion of berries
- Ingestion of fish

Although all public receptor exposures to herbicide active ingredients used on public lands are considered to be accidental, public receptor exposures are evaluated under two scenarios. Routine-use exposures are assumed to occur when public receptors come into contact with environmental media that have been impacted by spray drift. As discussed earlier, dose-response values are available for short, intermediate, and long-term exposures. While it is possible that public receptors use public lands under intermediate and long term time frames, it is unlikely that public receptors would be exposed to herbicides under the routine use scenario for more than a short-term exposure, which is defined as 1 day to 1 month (USEPA 2001h). Therefore, short-term dose-response values are used to evaluate the public receptors under the routine use exposure scenario. To account for the unlikely possibility that public receptors could repeatedly enter areas that have been recently sprayed, the uncertainty analysis includes an evaluation of the public receptors under an intermediate and a long-term exposure scenario. Accidental exposures are assumed to occur when public receptors come into contact with environmental media that have been subject to direct spray or spills. Tables B-4 through B-9 show for each herbicide a.i. the receptors and exposure pathways evaluated. Each of these scenarios is discussed below.

Routine Use Exposure Scenarios

Signage is used to identify areas that are directly sprayed under the BLM vegetation treatment program and to warn against reentry. It is assumed that under routine conditions, these warnings are heeded. Therefore, public exposures under routine use scenarios

are assumed to occur "off-site," where "on-site" is the area that has been directly sprayed.

Although all precautions are taken to limit the amount of spray drift from an herbicide application, spray drift can result in deposition of herbicide on areas outside of the directly sprayed area. Spray drift is associated with larger spraying efforts, such as those from aerial or boom/broadcast applications. It is assumed that a public receptor could walk through vegetated areas upon which spray drift had settled. If the spray drift deposits in areas where there are wild berries, a public receptor could ingest those berries. Spray drift could also settle on bodies of water, and those water bodies could be contacted by a public receptor either while swimming or could be used as a source of water for drinking while hiking. Fish could also be ingested from spray drift-impacted bodies of water. Because spray drift could potentially affect several environmental media, the exposure scenarios developed for each receptor have assumed exposure to multiple environmental media.

The Native American scenario was developed following recommendations by the USEPA (2003e). The specific receptor is a Native American basket weaver involved in gathering plant materials and other activities related to weaving baskets. The USEPA suggests evaluating the dermal contact with foliage exposure pathway. In its memorandum, the USEPA states:

> "It is expected that the oral intake of herbicides will be minimal by comparison to the above dermal exposure pathway. That is because basket weavers tend to *"spit-off"* plant residues (due to after taste) when mouth stripping plant materials" (personal communication with M. Dong, California Department of Pesticide Regulation).

For completeness, in addition to the dermal contact pathway recommended by the USEPA (2003e), the Native American (adult and child) is also assumed to be exposed through spray drift, berry ingestion, dermal contact while swimming, water for drinking, and fish ingestion.

Accidental Exposure Scenarios

In addition to exposures due to inadvertent spray drift, this HHRA also evaluates potential acute accidental exposures by public receptors to the herbicides. Accidental exposure could occur through direct spray and spills. The same types of receptors introduced above are also evaluated for the accidental scenarios. However, because direct spray or spills are localized, exposures to multiple media are not assumed in these scenarios. It is assumed that each of the herbicides could be directly sprayed onto humans, foliage, and berries, and each of the herbicides could be directly sprayed or spilled into a water body. For the aquatic herbicides (fluridone and diquat), the direct spray pathway is a reentry scenario.

Direct Spray

Direct Spray on Receptors. In this scenario it is assumed that a receptor is accidentally sprayed with herbicide because they have entered a spray area and are beneath a spray aircraft or other mode of application. Direct spray contact is evaluated for:

- Adult receptor - hiker/hunter, berry picker, angler, nearby resident, and Native American
- Child receptor - berry picker, nearby resident, and Native American

Contact with Directly Sprayed Vegetation. Re-entry is a term used to describe entering an area that has just been sprayed (i.e., an "on-site" area, in contrast with the scenarios in the previous section where exposure to areas of "off-site" spray drift deposition is evaluated). Contact with just-sprayed vegetation may result in dermal exposure by hikers, berry pickers, and anglers. In addition, berry pickers may ingest directly sprayed fruit. This scenario is also evaluated for the aquatic herbicides, diquat and fluridone, assuming inadvertent spraying of terrestrial vegetation.

Dermal contact with just-sprayed vegetation is evaluated for:

- Adult receptor - hiker/hunter, berry picker, angler, nearby resident, and Native American
- Child receptor - berry picker, nearby resident, and Native American

Ingestion of directly sprayed berries is evaluated for:

- Adult receptor - berry picker, nearby resident, and Native American
- Child receptor - berry picker, nearby resident, and Native American

Direct Spray onto Water Body. Direct spray onto water bodies could occur inadvertently for the three herbicides that are used for terrestrial applications (diflufenzopyr, imazapic, and sulfometuron methyl). The aquatic herbicides, diquat and fluridone, would be

used for treatment of the water body. Therefore, exposure to a water body treated with diquat and fluridone is similar to a re-entry scenario evaluated for the terrestrial herbicides. The exposure scenarios for both the inadvertently-sprayed and treated water bodies are the same. Incidental ingestion and dermal contact with water while swimming is evaluated for:

- Adult receptor - swimmer
- Child receptor - swimmer

In addition, the Native American child and adult receptors are evaluated for dermal contact while swimming and ingestion of drinking water. While incidental ingestion of water could occur for this receptor while swimming, incidental ingestion was not evaluated separately because it results in minimal exposure compared to drinking water exposure.

An angler could fish in and ingest fish from a directly sprayed water body. Therefore, fish ingestion is evaluated for:

- Adult receptor – angler and Native American
- Child receptor - Native American

In addition, hikers, berry pickers, anglers, and Native American receptors could get part of their day's water for drinking from a directly sprayed water body. Occasional drinking water ingestion is evaluated for:

- Adult receptor - hiker/hunter, berry picker, angler, and Native American
- Child receptor - berry picker and Native American

Spills

Members of the public may be exposed to an herbicide present in water if a load of herbicide mixture is spilled or if a container of herbicide concentrate breaks open and spills into a pond. Under this scenario, it is assumed that a fully loaded truck or helicopter empties its contents into a pond while transporting herbicide to an application site. However, it is BLM policy that herbicides are mixed at the application site. Therefore, this scenario represents a conservative, worst-case scenario that is unlikely to occur.

To evaluate this scenario, it is assumed that a pond is subjected to a spill of 140 gallons of herbicide mix from a helicopter or 200 gallons of herbicide mix from a batch truck. These amounts are approximately the largest amounts that can be carried in helicopters or trucks, respectively, as used by the BLM. It is assumed that the pond size is ¼ acre and 1 meter deep, in accordance with the Ecological Risk Assessment (ERA) Protocol (ENSR 2004).

The same receptors and exposure pathways listed above for the directly sprayed water body are evaluated for the water body that has received a direct spill.

Exposure Parameters for Public Receptors

Exposure parameters are the same for routine-use and accidental scenarios. Various guidelines and databases, such as the USEPA's *Exposure Factors Handbook* (USEPA 1997a) and their draft paper "Framework for Assessing Non-Occupational, Non-Dietary (Residential) Exposure to Pesticides" (USEPA 1998b), were used to develop the exposure parameters. For each exposure scenario, the exposure parameters were used to calculate an exposure factor (EF), which is then used in risk calculations. The use of the EF combines all the exposure parameters into one value in order to simplify the risk calculations. All adult receptors are assumed to weigh 70 kg, and child receptors are assumed to weigh 15 kg (USEPA 1991).

Hiker/Hunter

The hiker/hunter (adult) is assumed to be potentially exposed to herbicides via dermal contact with spray, dermal contact with sprayed foliage, and ingestion of drinking water from a sprayed pond. The hiker/hunter is assumed to weigh 70 kg and ingest 2 liters (½ gallon) of water while hiking (USEPA 1991). It is assumed that the hiker/hunter's lower legs, lower arms, and hands are exposed for potential herbicide contact. The 50th percentile SA of the lower legs, lower arms, and hands for men and women is 4,504 cm^2 (698 in^2) and was calculated based on data in the *Exposure Factors Handbook* (USEPA 1997a). The 50th percentile values were used in accordance with USEPA guidance (USEPA 1989). The hiker/hunter is assumed to contact foliage for 2 hours per day. This is the 50th percentile value for time spent outdoors away from dwelling or vehicles (USEPA 1997a). The dermal Transfer Coefficient (Tc) is used to estimate the amount of herbicide that may be transferred from foliage to skin. A Tc value of 1,000 cm^2/hour (155 in^2/hour) was selected for the hiker/hunter. The Tc is the central tendency value for scouting grapes and sweet corn, and was recommended as a surrogate for scouting activity for berries (USEPA 2000b [referenced by USEPA 2002c]).

Berry Picker

The berry pickers (adult and child) are assumed to be potentially exposed to herbicides via dermal contact with spray, dermal contact with sprayed foliage, ingestion of drinking water from a sprayed pond, and ingestion of berries containing spray. The adult berry picker is assumed ingest 2 liters (½ gallon) of water while berry picking, and the child berry picker is assumed to ingest 1 liter (1 quart) of water while berry picking (USEPA 1991). It is assumed that the berry picker's lower legs, lower arms, and hands are exposed for potential herbicide contact. The 50th percentile SA of the lower legs, lower arms, and hands for adult men and women is 4,504 cm^2 (698 in^2), and was calculated based on data in the *Exposure Factors Handbook* (USEPA 1997a). The 50th percentile SA of the lower legs, lower arms, and hands for children is 1,607 cm^2 (249 in^2), and was calculated based on data in the *Exposure Factors Handbook* (USEPA 1997a). The adult and child berry pickers are assumed to contact foliage for 2 hours per day. A Tc value of 1,500 cm^2/hour (232 in^2/hour) was selected for the adult berry picker. This value is the high end Tc for harvesting blueberries (USEPA 2000b). A value of 300 cm^2/hour (47 in^2/hour) based on the child to adult surface area ratio (SAR; CalEPA 1996) was selected for the child berry picker.

Berry ingestion rates (IRs) for this receptor were assumed to be the same as those used for the Native American adult and child. Harper et al. (2002) list an IR of 320 g/day (11 ounces/day) for an adult for above ground gathered terrestrial vegetation for the Native American Spokane tribe. Berries are likely to be a small fraction of this 320 g/day. However, since this rate was not subdivided into additional categories, it was conservatively assumed that the IR for berries is 320 g/day for an adult Native American. The use of this value for the berry picker receptor is conservative because the berry IR for the berry picker is likely to be lower than that for the Native American, who could have a higher rate of subsistence activities. For the child berry picker, the IR was scaled by BW (i.e., 320 g/day x 15 kg [33 lbs] / 70 kg [154 lbs]) to 69 g [2.4 ounces] / day.

The berry IR was converted to units of cm^2/day because of the equation used to evaluate this pathway (USEPA 2002c).

Angler

The angler (adult) is assumed to be potentially exposed to herbicides via dermal contact with spray, dermal contact with sprayed foliage, ingestion of drinking water from a sprayed pond, and ingestion of fish from a sprayed pond. The angler is assumed ingest 2 liters (½ gallon) of water while fishing (USEPA 1991). It is assumed that the angler's lower legs, lower arms, and hands are exposed for potential herbicide contact. The 50th percentile SA of the lower legs, lower arms, and hands for men and women is 4,504 cm^2 (698 in^2), and was calculated based on data in the *Exposure Factors Handbook* (USEPA 1997a). The angler is assumed to contact foliage for 2 hours per day. A Tc value of 1,000 cm^2/hour (155 in^2/hour) was selected for the angler, similar to the value used for the hiker/hunter. The Tc is the central tendency value for scouting grapes and sweet corn, and was recommended as a surrogate for scouting activity for berries (USEPA 2000b [referenced by USEPA 2002c]). The angler is assumed to ingest 63 grams (2.2 ounces) of fish per day, which is the 95th percentile long-term fish IR listed in the *Exposure Factors Handbook* (USEPA 1997c) for the general population.

Swimmer

The swimmers (adult and child) are assumed to be potentially exposed to herbicides via dermal contact with and incidental ingestion of water from a sprayed pond. The USEPA (2001d) recommends an exposed SA of 18,000 cm^2 (2,790 in^2) for an adult swimmer and 6,600 cm^2 (1,023 in^2) for a child swimmer. It is assumed that 50 milliliters (mL; 0.05 L; 0.05 quart) of water are ingested from the pond while swimming for an hour (USEPA 1989).

Nearby Resident

The nearby residents (adult and child) are assumed to be potentially exposed to herbicides via dermal contact with spray, dermal contact with sprayed foliage, and ingestion of berries containing spray. It is assumed that the resident could contact foliage in their yard, as well as foliage areas outside the house. It is assumed that the resident gathers berries from bushes located outside the house.

It is assumed that the resident's lower legs, lower arms, and hands are exposed for potential herbicide a.i. contact. The 50th percentile SA of the lower legs, lower arms, and hands for adult men and women is 4,504 cm^2 (698 in^2), and was calculated based on data in the *Exposure Factors Handbook* (USEPA 1997a). The 50th percentile SA of the lower legs, lower arms, and hands for children is 1,607 cm^2 (249 in^2) and was calculated based on data in the *Exposure Factors Handbook*

TABLE B-4
Summary of Herbicide Use - Dicamba

Program	Scenario	Vehicle	Method	Application Information: Acres Treated Per Hour: Typical	Max	Herbicide[1]: Dicamba Portion of Distinct®/Overdrive®: Used (Y/N)?	Typical Rate (lb a.i./acre)	Max Rate (lb a.i./acre)
Rangeland	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	Y	0.1875	0.25
			Horseback	0.75	1	Y	0.1875	0.25
		ATV	Spot	0.25	0.5	Y	0.1875	0.25
			Boom/broadcast	0.8	1.6	Y	0.1875	0.25
		Truck mount	Spot	0.38	1	Y	0.1875	0.25
			Boom/broadcast	1.5	2.25	Y	0.1875	0.25
Public Domain Forest Land	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA
Energy and Mineral Sites	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	Y	0.1875	0.25
			Horseback	0.75	1	Y	0.1875	0.25
		ATV	Spot	0.25	0.5	Y	0.1875	0.25
			Boom/broadcast	0.8	1.6	Y	0.1875	0.25
		Truck mount	Spot	0.38	1	Y	0.1875	0.25
			Boom/broadcast	1.5	2.25	Y	0.1875	0.25
Rights-of-way	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	Y	0.1875	0.25
			Horseback	0.75	1	Y	0.1875	0.25
		ATV	Spot	0.25	0.5	Y	0.1875	0.25
			Boom/broadcast	0.8	1.6	Y	0.1875	0.25
		Truck mount	Spot	0.38	1	Y	0.1875	0.25
			Boom/broadcast	1.5	2.25	Y	0.1875	0.25

TABLE B-4 (Cont.)
Summary of Herbicide Use - Dicamba

Program	Application Information					Herbicide[1]		
				Acres Treated Per Hour		Dicamba Portion of Distinct®/Overdrive®		
	Scenario	Vehicle	Method	Typical	Max	Used (Y/N)?	Typical Rate (lb a.i./acre)	Max Rate (lb a.i./acre)
Recreation and Cultural Sites	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	Y	0.1875	0.25
			Horseback	0.75	1	Y	0.1875	0.25
		ATV	Spot	0.25	0.5	Y	0.1875	0.25
			Boom/broadcast	0.8	1.6	Y	0.1875	0.25
		Truck mount	Spot	0.38	1	Y	0.1875	0.25
			Boom/broadcast	1.5	2.25	Y	0.1875	0.25
Aquatic	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA
	Aquatic	Boat (diquat)	Spot	0.63	2	N	NA	NA
			Boom/broadcast	1.3	3	N	NA	NA
		Boat (fluridone)	Boom/broadcast (granular)	6.25	5.8	NA	NA	NA
			Boom/broadcast (liquid)	17.5	16.7	NA	NA	NA

[1] All data are based on a single application.
Typical = Typical application rate; and Max = Maximum application rate.
NA = Not applicable.

TABLE B-5
Summary of Herbicide Use - Diflufenzopyr

Program	Application Information					Herbicide[1]		
				Acres Treated Per Hour		Diflufenzopyr portion of Distinct®/Overdrive®		
	Scenario	Vehicle	Method	Typical	Max	Used (Y/N)?	Typical Rate (lb a.i./acre)	Max Rate (lb a.i./acre)
Rangeland	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	Y	0.075	0.1
			Horseback	0.75	1	Y	0.075	0.1
		ATV	Spot	0.25	0.5	Y	0.075	0.1
			Boom/broadcast	0.8	1.6	Y	0.075	0.1
		Truck mount	Spot	0.38	1	Y	0.075	0.1
			Boom/broadcast	1.5	2.25	Y	0.075	0.1
Public Domain Forest Land	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA
Energy and Mineral Sites	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	Y	0.075	0.1
			Horseback	0.75	1	Y	0.075	0.1
		ATV	Spot	0.25	0.5	Y	0.075	0.1
			Boom/broadcast	0.8	1.6	Y	0.075	0.1
		Truck mount	Spot	0.38	1	Y	0.075	0.1
			Boom/broadcast	1.5	2.25	Y	0.075	0.1
Rights-of-way	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	Y	0.075	0.1
			Horseback	0.75	1	Y	0.075	0.1
		ATV	Spot	0.25	0.5	Y	0.075	0.1
			Boom/broadcast	0.8	1.6	Y	0.075	0.1
		Truck mount	Spot	0.38	1	Y	0.075	0.1
			Boom/broadcast	1.5	2.25	Y	0.075	0.1

TABLE B-5 (Cont.)
Summary of Herbicide Use - Diflufenzopyr

Program	Application Information					Herbicide[1]		
				Acres Treated Per Hour		Diflufenzopyr portion of Distinct®/Overdrive®		
Program	Scenario	Vehicle	Method	Typical	Max	Used (Y/N)?	Typical Rate (lb a.i./acre)	Max Rate (lb a.i./acre)
Recreation and Cultural Sites	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	Y	0.075	0.1
			Horseback	0.75	1	Y	0.075	0.1
		ATV	Spot	0.25	0.5	Y	0.075	0.1
			Boom/broadcast	0.8	1.6	Y	0.075	0.1
		Truck mount	Spot	0.38	1	Y	0.075	0.1
			Boom/broadcast	1.5	2.25	Y	0.075	0.1
Aquatic	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA
	Aquatic	Boat (diquat)	Spot	0.63	2	N	NA	NA
			Boom/broadcast	1.3	3	N	NA	NA
		Boat (fluridone)	Boom/broadcast (granular)	6.25	5.8	N	NA	NA
			Boom/broadcast (liquid)	17.5	16.7	N	NA	NA

[1] All data are based on a single application.
Typical = Typical application rate; and Max = Maximum application rate.
NA = Not applicable.

TABLE B-6
Summary of Herbicide Use - Diquat

Program	Application Information					Herbicide[1]		
	Scenario	Vehicle	Method	Acres Treated Per Hour		Diquat (Reward®)[2]		
				Typical	Max	Used (Y/N)?	Typical Rate (lb a.i./acre)	Max Rate (lb a.i./acre)
Rangeland	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA
Public Domain Forest Land	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA
Energy and Mineral Sites	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA
Rights-of-way	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA

TABLE B-6 (Cont.)
Summary of Herbicide Use - Diquat

Program	Scenario	Vehicle	Method	Acres Treated Per Hour		Herbicide[1] Diquat (Reward®)[2]		
				Typical	Max	Used (Y/N)?	Typical Rate (lb a.i./acre)	Max Rate (lb a.i./acre)
Recreation and Cultural Sites	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA
Aquatic	Aerial	Plane	Fixed wing	250	500	Y	1	4
		Helicopter	Rotary	100	200	Y	1	4
	Ground	Human	Backpack	0.2	0.4	Y	1	4
			Horseback	0.75	1	Y	1	4
		ATV	Spot	0.25	0.5	Y	1	4
			Boom/broadcast	0.8	1.6	Y	1	4
		Truck mount	Spot	0.38	1	Y	1	4
			Boom/broadcast	1.5	2.25	Y	1	4
	Aquatic	Boat (diquat)	Spot	0.63	2	Y	1	4
			Boom/broadcast	1.3	3	Y	1	4
		Boat (fluridone)	Boom/broadcast (granular)	6.25	5.8	N	NA	NA
			Boom/broadcast (liquid)	17.5	16.7	N	NA	NA

[1] All data are based on a single application.
[2] BLM specified typical and maximum application rates for four different water bodies: Ponds, Whole Lake/Reservoir, Partial Lakes/Reservoir, and Canals. The highest typical application rate (Pond) was selected for use as the typical rate and the highest maximum application rate (Partial Lake/Reservoir) was selected for use as the maximum application rate. Application rates are dependent on water depth, which is assumed to be 1 meter (3.3 feet).
Typical = Typical application rate; and Max = Maximum application rate.
NA = Not applicable.

TABLE B-7
Summary of Herbicide Use - Fluridone

Program	Application Information					Herbicide[1]		
				Acres Treated Per Hour		Fluridone (Sonar®)[2]		
	Scenario	Vehicle	Method	Typical	Max	Used (Y/N)?	Typical Rate (lb a.i./acre)	Max Rate (lb a.i./acre)
Rangeland	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA
Public Domain Forest Land	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA
Energy and Mineral Sites	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA
Rights-of-way	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA

TABLE B-7 (Cont.)
Summary of Herbicide Use - Fluridone

Program	Application Information					Herbicide[1]		
				Acres Treated Per Hour		Fluridone (Sonar®)[2]		
	Scenario	Vehicle	Method	Typical	Max	Used (Y/N)?	Typical Rate (lb a.i./acre)	Max Rate (lb a.i./acre)
Recreation and Cultural Sites	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA
Aquatic	Aerial	Plane	Fixed wing	250	500	Y	0.41	1.3
		Helicopter	Rotary	100	200	Y	0.41	1.3
	Ground	Human	Backpack	0.2	0.4	Y	0.41	1.3
			Horseback	0.75	1	Y	0.41	1.3
		ATV	Spot	0.25	0.5	Y	0.41	1.3
			Boom/broadcast	0.8	1.6	Y	0.41	1.3
		Truck mount	Spot	0.38	1	Y	0.41	1.3
			Boom/broadcast	1.5	2.25	Y	0.41	1.3
	Aquatic	Boat (diquat)	Spot	0.63	2	N	NA	NA
			Boom/broadcast	1.3	3	N	NA	NA
		Boat (fluridone)	Boom/broadcast (granular)	6.25	5.8	Y	0.41	1.3
			Boom/broadcast (liquid)	17.5	16.7	Y	0.41	1.3

[1] All data are based on a single application.
[2] BLM specified typical and maximum application rates for four different water bodies: Ponds, Whole Lake/Reservoir, Partial Lakes/Reservoir, and Canals. The highest typical application rate (Pond) was selected for use as the typical rate and the highest maximum application rate (Partial Lake/Reservoir) was selected for use as the maximum application rate. Application rates are dependent on water depth, which is assumed to be 1 meter (3.3 feet).
Typical = Typical application rate: and Max = Maximum application rate.
NA = Not applicable.

TABLE B-8
Summary of Herbicide Use - Imazapic

Program	Application Information					Herbicide[1]		
				Acres Treated Per Hour		Imazapic (Plateau®)		
	Scenario	Vehicle	Method	Typical	Max	Used (Y/N)?	Typical Rate (lb a.i./acre)	Max Rate (lb a.i./acre)
Rangeland	Aerial	Plane	Fixed wing	250	500	Y	0.031	0.19
		Helicopter	Rotary	100	200	Y	0.031	0.19
	Ground	Human	Backpack	0.2	0.4	Y	0.031	0.19
			Horseback	0.75	1	Y	0.031	0.19
		ATV	Spot	0.25	0.5	Y	0.031	0.19
			Boom/broadcast	0.8	1.6	Y	0.031	0.19
		Truck mount	Spot	0.38	1	Y	0.031	0.19
			Boom/broadcast	1.5	2.25	Y	0.031	0.19
Public Domain Forest Land	Aerial	Plane	Fixed wing	250	500	Y	0.031	0.19
		Helicopter	Rotary	100	200	Y	0.031	0.19
	Ground	Human	Backpack	0.2	0.4	Y	0.031	0.19
			Horseback	0.75	1	Y	0.031	0.19
		ATV	Spot	0.25	0.5	Y	0.031	0.19
			Boom/broadcast	0.8	1.6	Y	0.031	0.19
		Truck mount	Spot	0.38	1	Y	0.031	0.19
			Boom/broadcast	1.5	2.25	Y	0.031	0.19
Energy and Mineral Sites	Aerial	Plane	Fixed wing	250	500	Y	0.031	0.19
		Helicopter	Rotary	100	200	Y	0.031	0.19
	Ground	Human	Backpack	0.2	0.4	Y	0.031	0.19
			Horseback	0.75	1	Y	0.031	0.19
		ATV	Spot	0.25	0.5	Y	0.031	0.19
			Boom/broadcast	0.8	1.6	Y	0.031	0.19
		Truck mount	Spot	0.38	1	Y	0.031	0.19
			Boom/broadcast	1.5	2.25	Y	0.031	0.19
Rights-of-way	Aerial	Plane	Fixed wing	250	500	Y	0.031	0.19
		Helicopter	Rotary	100	200	Y	0.031	0.19
	Ground	Human	Backpack	0.2	0.4	Y	0.031	0.19
			Horseback	0.75	1	Y	0.031	0.19
		ATV	Spot	0.25	0.5	Y	0.031	0.19
			Boom/broadcast	0.8	1.6	Y	0.031	0.19
		Truck mount	Spot	0.38	1	Y	0.031	0.19
			Boom/broadcast	1.5	2.25	Y	0.031	0.19

TABLE B-8 (Cont.)
Summary of Herbicide Use - Imazapic

Program	Scenario	Vehicle	Method	Acres Treated Per Hour Typical	Acres Treated Per Hour Max	Imazapic (Plateau®) Used (Y/N)?	Typical Rate (lb a.i./acre)	Max Rate (lb a.i./acre)
Recreation and Cultural Sites	Aerial	Plane	Fixed wing	250	500	Y	0.031	0.19
		Helicopter	Rotary	100	200	Y	0.031	0.19
	Ground	Human	Backpack	0.2	0.4	Y	0.031	0.19
			Horseback	0.75	1	Y	0.031	0.19
		ATV	Spot	0.25	0.5	Y	0.031	0.19
			Boom/broadcast	0.8	1.6	Y	0.031	0.19
		Truck mount	Spot	0.38	1	Y	0.031	0.19
			Boom/broadcast	1.5	2.25	Y	0.031	0.19
Aquatic	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA
	Aquatic	Boat (diquat)	Spot	0.63	2	N	NA	NA
			Boom/broadcast	1.3	3	N	NA	NA
		Boat (fluridone)	Boom/broadcast (granular)	6.25	5.8	N	NA	NA
			Boom/broadcast (liquid)	17.5	16.7	N	NA	NA

Herbicide[1]

[1] All data are based on a single application.
Typical = Typical application rate; and Max = Maximum application rate.
NA = Not applicable.

TABLE B-9
Summary of Herbicide Use - Sulfometuron Methyl

Program	Application Information					Herbicide[1]		
				Acres Treated Per Hour		Sulfometuron Methyl (Oust®)		
Program	Scenario	Vehicle	Method	Typical	Max	Used (Y/N)?	Typical Rate (lb a.i./acre)	Max Rate (lb a.i./acre)
Rangeland	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA
Public Domain Forest Land	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	Y	0.14	0.38
	Ground	Human	Backpack	0.2	0.4	Y	0.14	0.38
			Horseback	0.75	1	Y	0.14	0.38
		ATV	Spot	0.25	0.5	Y	0.14	0.38
			Boom/broadcast	0.8	1.6	Y	0.14	0.38
		Truck mount	Spot	0.38	1	Y	0.14	0.38
			Boom/broadcast	1.5	2.25	Y	0.14	0.38
Energy and Mineral Sites	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	Y	0.14	0.38
	Ground	Human	Backpack	0.2	0.4	Y	0.14	0.38
			Horseback	0.75	1	Y	0.14	0.38
		ATV	Spot	0.25	0.5	Y	0.14	0.38
			Boom/broadcast	0.8	1.6	Y	0.14	0.38
		Truck mount	Spot	0.38	1	Y	0.14	0.38
			Boom/broadcast	1.5	2.25	Y	0.14	0.38
Rights-of-way	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	Y	0.14	0.38
	Ground	Human	Backpack	0.2	0.4	Y	0.14	0.38
			Horseback	0.75	1	Y	0.14	0.38
		ATV	Spot	0.25	0.5	Y	0.14	0.38
			Boom/broadcast	0.8	1.6	Y	0.14	0.38
		Truck mount	Spot	0.38	1	Y	0.14	0.38
			Boom/broadcast	1.5	2.25	Y	0.14	0.38

TABLE B-9 (Cont.)
Summary of Herbicide Use - Sulfometuron Methyl

Program	Application Information					Herbicide[1]		
				Acres Treated Per Hour		Sulfometuron Methyl (Oust®)		
	Scenario	Vehicle	Method	Typical	Max	Used (Y/N)?	Typical Rate (lb a.i./acre)	Max Rate (lb a.i./acre)
Recreation and Cultural Sites	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	Y	0.14	0.38
			Horseback	0.75	1	Y	0.14	0.38
		ATV	Spot	0.25	0.5	Y	0.14	0.38
			Boom/broadcast	0.8	1.6	Y	0.14	0.38
		Truck mount	Spot	0.38	1	Y	0.14	0.38
			Boom/broadcast	1.5	2.25	Y	0.14	0.38
Aquatic	Aerial	Plane	Fixed wing	250	500	N	NA	NA
		Helicopter	Rotary	100	200	N	NA	NA
	Ground	Human	Backpack	0.2	0.4	N	NA	NA
			Horseback	0.75	1	N	NA	NA
		ATV	Spot	0.25	0.5	N	NA	NA
			Boom/broadcast	0.8	1.6	N	NA	NA
		Truck mount	Spot	0.38	1	N	NA	NA
			Boom/broadcast	1.5	2.25	N	NA	NA
	Aquatic	Boat (diquat)	Spot	0.63	2	N	NA	NA
			Boom/broadcast	1.3	3	N	NA	NA
		Boat (fluridone)	Boom/broadcast (granular)	6.25	5.8	N	NA	NA
			Boom/broadcast (liquid)	17.5	16.7	N	NA	NA

[1] All data are based on a single application.
Typical = Typical application rate; and Max = Maximum application rate.
NA = Not applicable.

(USEPA 1997a). The adult and child resident are assumed to contact foliage for 2 hours per day. A Tc value of 14,500 cm^2/hour (2,248 in^2/hr) was selected for the adult resident, and 5,200 cm^2/hour (806 in^2/hr) was selected for the child resident (USEPA 2001i). These Tc values are higher than those used for the other receptors, and assumes that contact with herbicide active ingredients in foliage could occur in the residents' yards (i.e., playing in the grass is an activity that could result in greater transfer than walking through the brush or woods).

Berry IRs for this receptor were assumed to be the same as those used for the Native American adult and child. The rates are 320 g/day (11 ounces/day) for an adult and a scaled IR of 69 g/day (2.4 ounces/day) for a child, and are based on rates of above ground gathered terrestrial vegetation for the Native American Spokane tribe (Harper et al. 2002). The berry IR was converted to units of cm^2/day because of the requirements of the equation used to evaluate this pathway (USEPA 2002c).

Native American

The Native American receptors (adult and child) are assumed to be potentially exposed to herbicides via dermal contact with spray, dermal contact with sprayed foliage, ingestion of drinking water from a sprayed pond, ingestion of berries containing spray, dermal contact with water in a sprayed pond, and ingestion of fish from a sprayed pond. The adult Native American is assumed ingest 1 liter (1 quart) of water per day (Harper et al. 2002) from the sprayed pond. According to Harper et al., a representative Spokane Tribe subsistence exposure scenario assumes that an adult consumes 4 liters (1 gallon) of water per day out of which 2 liters/day (2 quarts/day) are consumed from the home drinking water well, 1 liter/day (1 quart/day) is consumed at the work site, and 1 liter/day is consumed in a sweat lodge (where water is poured over hot rocks to create a steam bath). It is assumed that the 1 liter/day from the work site could come from a sprayed pond. The child Native American is assumed to consume half the adult rate resulting in 0.5 liter/day (½ quart) from a sprayed pond.

Harris and Harper (1997) and Harper et al. (2002) do not provide specific data regarding Native American body SA or BW. It is assumed that the Native American's lower legs, lower arms, and hands are exposed for potential herbicide contact. The 50th percentile SA of the lower legs, lower arms, and hands for adult men and women is 4,504 cm^2 (698 in^2), and was calculated based on data in the *Exposure Factors Handbook* (USEPA 1997c). The 50th percentile SA of the lower legs, lower arms, and hands for children is 1,607 cm^2 (249 in^2), and was calculated based on data in the *Exposure Factors Handbook* (USEPA 1997a). The Native American receptors are assumed to contact foliage for 3 hours per day of subsistence activities (Harper et al. 2002). A Tc value of 1,500 cm^2/hour (233 in^2/hour) was selected for the adult. This value is the high end Tc for harvesting blueberries (USEPA 2000b). A value of 300 cm^2/hour (47 in^2/hour), based on the child to adult SAR (CalEPA 1996), was selected for the child.

The USEPA (2001d) recommends an exposed SA of 18,000 cm^2 (2,790 in^2) for an adult swimmer and 6,600 cm^2 (1,023 in^2) for a child swimmer. Because no specific data are available regarding SA, these estimates have been used to evaluate the Native American child and adult in this HHRA. The ET for swimming is assumed to be 2.6 hours/day in accordance with Harris and Harper (1997) which gives a swimming exposure frequency of 2.6 hours/day for 70 days/year. Incidental ingestion during swimming is not evaluated for the Native American since it is assumed that the pond is also used as a source of drinking water, and any incidental ingestion during swimming is therefore included in the drinking water scenario.

The berry IR was developed from information provided in Harper et al. (2002), which lists an IR of 320 g/day for an adult for above ground gathered terrestrial vegetation for the Native American Spokane tribe. Berries are likely to be a small fraction of this 320 g/day. However, since this rate was not subdivided into additional categories, it was conservatively assumed that the IR for berries is 320 g/day for an adult Native American. For the child Native American, the IR was scaled by BW (i.e., 320 g/day x 15 kg [33 lbs] / 70 kg [154 lbs]) to 69 g /day (2.4 ounces/day; per CalEPA 1996).

The adult fish IR was assumed to be 885 g/day (1.9 lbs) based on a high fish diet scenario Harper et al. (2002). The high fish diet consists primarily of fish, supplemented by big game, amphibians, crustaceans, mollusks, small mammals, and upland game birds. This value is much higher than the 95th percentile fish IR of 170 g/day (6 ounces) recommended in USEPA (1997a) for a Native American subsistence population. For the child Native American, the IR was scaled by BW (i.e., 885 g/day x 15 kg [33 lbs] / 70 kg [154 lbs]) to 190 g [6.7 ounces] /day; CalEPA 1996).

Calculation of Exposure Point Concentrations

Exposure points are located where potential receptors may contact herbicides. The herbicide concentration in the environmental medium that receptors may contact must be estimated in order to determine the magnitude of potential exposure. The concentration at the point of contact is referred to as the exposure point concentration (EPC).

Occupational Exposures

It is assumed that workers could be exposed via dermal contact and inhalation through routine-use of herbicides and via an accidental spill to worker skin.

Routine Exposures

For the routine exposures, the exposure dose is calculated using the herbicide AR (lbs a.i./day) and the AT per day. This information is provided in Tables B-4 to B-9.

Accidental Exposures

To calculate exposures from an accidental spill to worker skin, the concentration of a.i. in the formulation (in lbs of a.i. per gallon of formulation) must be derived. These concentrations are provided or can be calculated from the information provided on the herbicide labels. Three of the herbicides evaluated in the risk assessment (diquat, fluridone, and imazapic) may be present in a concentrated liquid formulation. Fluridone and imazapic are also present in a dry formulation; however, for this evaluation it is assumed that the worker is exposed to the concentrated liquid formulation. For the worker spill scenario, it is assumed that the worker is exposed to the concentrated liquid; therefore, the pounds of a.i. per gallon listed on the labels are used for the calculation. For diquat, fluridone, and imazapic, the concentrated liquid concentrations are 2 pounds a.i./gallon, 4 pounds a.i./gallon, and 2 pounds a.i./gallon, respectively.

Diflufenzopyr and sulfometuron methyl are in a dry form, and need to be mixed with water before application. The concentration of a.i. present in the application-ready formulation is calculated using maximum ARs (lb of a.i./acre, Tables B-4 to B-9) and the minimum spray rate (in gallons per acre, information provided by the BLM). The combination of maximum AR and minimum spray rate results in the most concentrated solution. The concentration is calculated using the following equation:

Concentration (lb a.i./gallon) = Application rate (pounds a.i./acre)/Spray rate (gallons/acre)

The helicopter spray rate of 5 gallons/acre results in the most concentrated solution, therefore the helicopter spray rate is used in the calculation. The maximum ARs for diflufenzopyr and sulfometuron methyl of 0.1 pounds a.i./acre and 0.38 pounds a.i./acre, respectively, is divided by the spray rate (5 gallons/acre) resulting in concentrations of 0.02 pounds a.i./gallon and 0.076 pounds a.i./gallon, respectively.

The accidental spill scenario for diquat and fluridone resulted in unacceptable risks to occupational receptors. Because of the unlikely nature of the scenario (i.e., a spill of concentrated liquid directly to worker skin), EPCs were also calculated assuming a spill to worker skin after the herbicide is mixed at the maximum or typical AR using the equation listed above.

Public Exposures

It is assumed that the public could have routine exposures to herbicides present in spray drift that have deposited onto the receptor, foliage, ponds, and berries. It is also assumed that there could be accidental direct spray onto the receptor, foliage, pond, and berries, as well as a direct spill into the pond.

Routine Exposure Point Concentrations

Off-target spray drift refers to the amount of sprayed pesticide that does not come into contact with the target area, but rather drifts in the air and settles on an off-target area. The magnitude of potential human exposure to herbicides as a result of off-target spray drift and surface runoff of herbicides from the target application area was estimated from modeled terrestrial deposition rates (DRs) and water body concentrations. A hypothetical quarter acre, 1-meter deep pond was assumed for these calculations. Off-target spray drift and resulting terrestrial DRs and waterbody concentrations were predicted using the computer model AgDRIFT® (Spray Drift Task Force [SDTF] 2002). Surface runoff of herbicides from the target application area and resulting waterbody (hypothetical pond) concentrations were predicted using the computer model GLEAMS (Groundwater Loading Effects of Agricultural Management Systems).

AgDRIFT®. AgDRIFT® Version 2.0.05 (SDTF 2002) is a computer model that is a product of the Cooperative Research and Development Agreement between the USEPA's Office of Research and Development and the

SDTF (a coalition of pesticide registrants). It is based on, and represents an enhancement of, its preceding computer program, AGDISP (Agricultural Dispersal Model), which was developed by the National Aeronautics and Space Administration (NASA), the U.S. Department of Agriculture Forest Service (USDA Forest Service), and the U.S. Army. AgDRIFT® was developed for use in regulatory assessments of off-target drift associated with agricultural use of pesticides through aerial, ground, or orchard/airblast applications. AgDRIFT® is based upon the simple idea that pesticide or herbicide drift is primarily a function of application technique (e.g., droplet size and release height), environmental conditions, and physical properties of the spray solution and not of the a.i. itself. To implement this idea, the computational approach employed by AgDRIFT® is based on a simple method that has evolved over a period of more than 20 years and yields high correlation with field measurement datasets. AgDRIFT® was selected for use in this risk assessment because it allows for the simulation of a broad range of aerial and ground application practices and associated off-target spray drift. Further, the cooperative development of AgDRIFT® by the USEPA and the SDTF and the associated use of AgDRIFT® in regulatory assessments of off-target pesticide drift reinforces its suitability to this particular application.

AgDRIFT® enables the user to take a tiered approach to the modeling of drift by allowing the user to choose between three tiers of increasingly complex evaluations of off-target drift and deposition. The basic difference between the three tiers (Tiers I, II, and III) is the amount of control users have in selecting model input variables. Also, Tier I supports the evaluation of aerial and ground application scenarios, whereas Tiers II and III support the evaluation of only aerial application scenarios (for agricultural and forestry applications). Tier I is based on a set of standard "Good Application Practices" and requires little knowledge of the actual application conditions or herbicide properties. Tier I allows the user to modify a small number of model variables. Tiers II and III are based on the same set of "Good Application Practices" as Tier I. However, to implement either Tier II or III the user must have a progressively greater knowledge of the specific conditions under which herbicides will be applied. Tiers II and III allow the user to modify a progressively larger set of variables to make the scenario evaluated representative of the conditions under which herbicides will be applied.

Tier I was used in this EIS to evaluate off-target drift associated with ground application scenarios. Tier II was used to evaluate off-target drift associated with aerial application of herbicides to agricultural and forestry land types. The agricultural land type represents land having a relatively short vegetative canopy (e.g., non-forested land such as rangeland). The forestry land type represents land having a higher vegetative canopy (e.g., forested land). The Tier I ground application model does not allow the user to select between land types. It simply models drift from ground application in an agriculture-like setting. Both Tier I and Tier II of the AgDRIFT® model were utilized to evaluate off-target spray drift to a terrestrial area or waterbody (e.g., a hypothetical pond) located perpendicular to, and downwind of, the herbicide application area. The terrestrial area simply represents a point on the ground at a fixed distance downwind of the application area. AgDRIFT® calculates the DR (mg/cm^2) for the terrestrial location of interest. The hypothetical pond is intended to represent a non-flowing waterbody approximately ¼ acre in size and 1 meter deep. The concentration of the herbicide being modeled in pond water is generated in the AgDRIFT® model based on the assumption of instantaneous mixing throughout the waterbody. The implementation of the Tier I ground and Tier II aerial application model and the model input variables (including the variables specific to the application method and environmental setting and specific to the herbicide being evaluated) are discussed and presented in the HHRA protocol document (ENSR 2005).

GLEAMS. GLEAMS is a modified version of the CREAMS (Chemical Runoff Erosion Assessment Management System) model that was originally developed to evaluate non-point source pollution from agricultural field-size areas. One of the benefits of the GLEAMS model is the ability to estimate a wide range of potential herbicide exposure concentrations as a function of important site-specific parameters such as soil characteristics, annual precipitation, etc. The model simulates edge-of-field and bottom-of-root-zone loadings of water, sediment, pesticides (or herbicides), and plant nutrients from the complex climate-soil-management interactions. The GLEAMS model has evolved through several versions from its inception in 1984 to the present, and has been evaluated in numerous climatic and soil regions around the world. The model was selected for use in this investigation because of its widespread acceptance, its suitability to this particular application, and the previous use of the model to support similar risk assessments for the USDA Forest Service (SERA 2001).

In this application, the GLEAMS model was used to simulate the fate and transport of the three terrestrial herbicides considered in this HHRA from an area representing a typical BLM application area. The fate and transport of the three herbicides was simulated by GLEAMS using a precipitation record and three other model components intended to represent hydrology, erosion, and pesticide movement:

- *Precipitation Record* – Rainfall distribution was described in the GLEAMS model using a daily hyetograph from Medford, Oregon from 1990 when a total of approximately 13.5 inches of precipitation was recorded. The GLEAMS model used the hyetograph from 1990 to describe the annual distribution of precipitation during the model simulations and eight different precipitation totals including 5, 10, 25, 50, 100, 150, 200, and 250 inches/year. By scaling the eight different hypothetical precipitation totals by the precipitation record measured during 1990, the daily rainfall totals were increased in the model, while the annual distribution of precipitation was retained.

- *Hydrology* – The hydrology component of the GLEAMS model simulates the movement of water through an agricultural system by considering the effects of precipitation on surface runoff and percolation through the unsaturated zone. Three soil types were simulated in this application including silt, sand, and clay. The simulated application area was a 10-acre square with a 5% slope, and the climate applied to the simulation was the measured annual average at Medford, Oregon.

- *Erosion* – The erosion component of GLEAMS simulates the movement of sediment over the land surface using the Universal Soil Loss Equation (USLE). Typical values were used to represent the soil erodibility factor and a Manning Roughness coefficient.

- *Pesticide* – The pesticide component of the GLEAMS model was used to simulate the movement of the herbicides diflufenzopyr, imazapic, and sulfometuron methyl (the three herbicides designated for terrestrial deposition) through the ecosystem by associating the herbicides with both water and sediment. Literature values describing water solubility, foliar half-life, partitioning, washoff, and soil half-life were used to facilitate the GLEAMS model calculations.

The GLEAMS model was used to simulate the fate and transport and eventual waterbody (e.g., pond) loading of each of the three terrestrial herbicides assuming they were each applied to a single application area within the vicinity of a hypothetical pond and using combinations of each of the eight precipitation rates and each of the three soil types.

Ambient water concentrations were calculated for a pond immediately adjacent to the application field using model predicted runoff and percolation rates, and the mass of herbicide a.i. associated with each of these exports. Statistical values of concentrations were calculated using an entire year of predicted results extracted once the model had reached a quasi-steady state. The GLEAMS model provides daily predictions of herbicide a.i. export rates, which were used to calculate ambient water concentrations in a pond, and the daily values were used to determine short-term (7 day), intermediate-term (30 day), and long-term (annual) surface water concentrations. These exposure durations correspond to the exposure durations used to evaluate the toxicology endpoint data (Table B-3). Long-term concentrations were calculated as the annual daily average from the last year of the 10-year simulation. Intermediate-term concentrations were calculated as the maximum 30-day average from the last year of the 10-year simulation. Short-term concentrations were calculated as the maximum 7-day average from the last year of the 10-year simulation. While it is possible that public receptors use public lands under intermediate and long term time frames, it is unlikely that public receptors would be exposed to herbicides under the routine use scenario for more than a short-term exposure, which is defined as 1 day to 1 month (USEPA 2001g). Therefore, short-term concentrations are used to evaluate the public receptors under the routine use exposure scenario. An evaluation of the public receptors under an intermediate and a long-term exposure scenario is included in the Uncertainty Analysis.

Pond concentrations for 42 scenarios were calculated for each time frame (18 from varying soil type and precipitation totals and 24 from a sensitivity analysis where soil type and 5 other parameters were varied). The highest calculated pond concentrations were selected from all of the scenarios for each time frame in order to provide the most conservative pond concentrations as an input to the HHRA. The timeframes were selected to correlate with USEPA's

short-term, intermediate-term, and long-term NOAELs. A detailed discussion of the GLEAMS modeling approach is presented in the HHRA protocol document (ENSR 2005). The individual ERA reports developed for each herbicide contain a description of herbicide-specific GLEAMS model inputs and present a summary of GLEAMS model results for each herbicide.

Terrestrial Deposition Rates and Exposure Point Concentrations. The initial terrestrial DRs predicted using the AgDRIFT® Tier I ground application and Tier II aerial application models were used to evaluate the following potential human exposure pathways:

- Dermal contact with herbicide in spray drift
- Dermal contact with herbicide on foliage
- Ingestion of herbicides that have deposited on berries

Spray drift DRs were estimated for two application scenarios, aerial and ground. For the aerial scenario, AgDRIFT® evaluates two land types (agricultural and forestry) for estimation of DRs. As the agricultural land type represents land having a relatively short vegetative canopy, it was used to estimate spray drift DRs resulting from aerial applications over non-forested areas, while the forestry land type (representing land having a higher vegetative canopy) was used to estimate spray drift DRs resulting from aerial applications over forested areas. To encompass all possibilities, both sets of DRs were used to evaluate public receptor exposures. Deposition rates were also calculated separately for plane and helicopter applications; therefore, there are four sets of aerial DRs calculated using Tier II of the model:

- Agricultural land type, airplane application
- Agricultural land type, helicopter application
- Forestry land type, airplane application
- Forestry land type, helicopter application

Off-target spray drift and the resulting terrestrial impacts from the aerial application scenarios were predicted at distances of 100, 300, and 900 feet downwind of the herbicide application area. The closest distance to the receptor (e.g., 100 feet downwind), was used as the basis for the HHRA.

For ground applications using Tier I of the model, estimation of spray drift DR is not dependent on land type. Ground applications may be conducted using either a high boom or a low boom, and DRs vary by the height of the boom. Therefore, there are two sets of ground DRs calculated for each herbicide:

- Ground application, low boom
- Ground application, high boom

Off-target spray drift and the resulting terrestrial impacts from the ground application scenarios were predicted at distances of 25, 100, and 900 feet downwind of the herbicide application area. The closest distance to the receptor (e.g., 25 feet downwind) was used as the basis for the HHRA.

Pond Deposition Rates and Exposure Point Concentrations. The surface water (pond) herbicide concentrations predicted using AgDRIFT® represent short-lived concentrations due to off-target spray drift. It is likely that these predicted herbicide levels are flushed out of the hypothetical pond within a few days. For the aquatic herbicides, it is assumed that these herbicides are sprayed onto a target pond and the spray drift settles onto an adjacent pond that was not targeted for spraying.

The pond herbicide concentrations predicted using the GLEAMS model represent the potential impact of surface runoff of herbicides and assume a constant loading to the pond. Therefore, the GLEAMS concentrations represent potential longer-term concentrations in the pond. The processes of spray drift onto and surface runoff into a surface water body are not directly additive, since they may not occur over the same time frame. However, as a conservative approach, the hypothetical herbicide concentrations due to spray drift predicted using AgDRIFT® were used in calculating the short-, intermediate-, and long-term surface water EPCs for all six herbicides. The short-, intermediate-, and long-term concentrations of terrestrial herbicides calculating using the GLEAMS model were added to the AgDRIFT® predictions for those herbicides. Using AgDRIFT® output for short-, intermediate-, and long-term time frames is a conservative approach since AgDRIFT® mainly represents short-lived concentrations. These combined concentrations are used to evaluate:

- Dermal contact with herbicide in water while swimming
- Ingestion of herbicide in water used as drinking water or while swimming
- Ingestion of herbicide that may bioconcentrate in the edible tissue of recreationally caught fish

As for the terrestrial DRs, pond concentrations were calculated for several land types and application scenarios:

- Agricultural land type, airplane application
- Agricultural land type, helicopter application
- Forestry land type, airplane application
- Forestry land type, helicopter application
- Ground application, low boom
- Ground application, high boom

Off-target spray drift and the resulting aquatic impacts were predicted at distances 100, 300, and 900 feet downwind of the aerial application areas and 25, 100, and 900 feet downwind of the ground application areas. Again, for the HHRA, the nearest distances to the receptor were used (e.g., 100 feet and 25 feet downwind for the aerial and ground applications, respectively).

Accidental Exposure Point Concentrations. Accidental exposures involving direct spray are estimated using the herbicide ARs (in pounds of a.i. per acre) shown in Tables B-4 to B-9. It is assumed that the herbicide is sprayed at the maximum AR directly onto the receptor, foliage, berries, or pond. The equation used to calculate the pond concentration is as follows:

Pond concentration (mg/L) = (Application rate [lb a.i./acre] * 453,600 * 35.31 ft^3/m^3 x 0.001 m^3/L) / (43,530 ft^2/acre * pond depth [feet]).

Spill. It is assumed that a pond receives a spill of 140 gallons of herbicide mix from a helicopter or 200 gallons of spray mix from a batch truck. These amounts are approximately the largest amounts that can be carried in helicopters or trucks, respectively, as used by the BLM. Similar to the worker spill scenario, the concentration of a.i. in the formulation must be derived. It is assumed that the herbicides are present in application-ready concentrations as they are being transported. Therefore, for the herbicides that may be present in concentrated liquid form (diquat, fluridone, and imazapic), a diluted concentration is calculated. Diflufenzopyr and sulfometuron methyl are in solid form, and the concentration of a.i. in the application-ready formulation is calculated.

Similar to the worker spill scenario, the following equation is used to calculate the concentration of a.i. present in the application-ready formulation:

Concentration (pounds a.i./gallon) = (Application rate [pounds a.i./acre]) / (Spray rate [gallons/acre])

Two spray rates are used in the equation to represent spraying from helicopters and trucks. Based on information provided by the BLM, the lowest spray rate from a helicopter is 5 gallons/acre and from a truck is 25 gallons/acre. While a range of spray rates is possible, these spray rates represent the lower end of the range, and thus result in higher concentrations. Maximum ARs (shown in Tables B-4 to B-9) were used for each of the six herbicides. The equation used to calculate the pond concentration is as follows:

Pond concentration (mg/L) = (Gallons spilled * lb a.i./gallon * 453,600 mg/lb * 35.31 ft^3/m^3 * 0.001 m^3/L) / (43,530 ft^2/acre * pond size [acre] * pond depth [ft])

Both the accidental truck and helicopter spill scenarios for diquat resulted in unacceptable risks to public receptors. To provide a more realistic estimate of risk, EPCs were also calculated assuming spills at the typical AR using the equation listed above.

Chemical-specific Parameters

Several chemical-specific parameters are used in the calculation of exposure doses described in the next section. These include absorption factors, skin permeability factors, and bioconcentration factors (BCFs). Each parameter is described below.

Absorption Factors

Absorption factors are used in this HHRA when the endpoint used to select the NOAEL and the exposure in the environmental medium of interest differ. For example, absorption factors are used with the dermal NOAELs for diquat, fluridone, and imazapic because oral studies were used to determine the dermal NOAELs. The derivation of these absorption factors were discussed earlier for diquat, fluridone, and imazapic.

Skin Permeability Constants

The estimation of exposure doses resulting from incidental dermal contact with surface water requires the use of a dermal permeability constant (Kp) in units of centimeters per hour (cm/hr). This method assumes that the behavior of constituents dissolved in water is described by Fick's Law. In Fick's Law, the steady-state flux of the solute across the skin ($mg/cm^2/hr$) equals the permeability constant (Kp, cm/hr) multiplied

by the concentration difference of the solute across the membrane (mg/cm^3). This approach is discussed by the USEPA (USEPA 1989, 1992, 2001d). For the six herbicides evaluated in the risk assessment, Kps were calculated using an equation presented in the USEPA's *Supplemental Guidance for Dermal Risk Assessment* (USEPA 2001d).

Fish Bioconcentration Factors

To estimate concentrations of herbicides in fish tissue, a BCF is used to approximate the amount of herbicide that bioconcentrates from the water into the fish tissue.

Risk Characterization

The purpose of the risk characterization is to provide estimates of the potential risk to human health from exposure to herbicides. The results of the exposure assessment are combined with the results of the dose-response assessment to derive quantitative estimates of risk, or the probability of adverse health effects following assumed potential exposure to herbicides. Since none of the six herbicides evaluated in this HHRA are considered to be potential carcinogens by the USEPA, the potential noncancer risk associated with the herbicide use scenarios is estimated.

The USEPA risk assessment guidance for pesticides (USEPA 2000a) provides different noncancer methods for evaluating food and non-food exposures. For food exposure, a percent PAD (%PAD) method is used, and for non-food exposure, an MOE method is used. In order to estimate total exposure and risk from all exposure pathways, the USEPA has also developed an aggregate risk approach, which combines potential risks from various pathways expressed as MOEs and %PADs (USEPA 1999a, USEPA 2001b).

The following sections discuss the overall approach for risk characterization, present equations for quantifying exposure and risk, present the results of the risk characterization, and discuss uncertainties inherent in the risk assessment process.

Approach for Risk Characterization

The food (%PAD) and non-food (MOE) methods are summarized below, followed by the aggregate risk approach for combining these risk estimates.

Food (%PAD) Assessment

This assessment method evaluates exposures to herbicide residues in food and water. Toxicity is represented by a PAD and may be calculated for acute effects (acute PAD) or chronic effects (chronic PAD). A PAD is defined as an acute or chronic RfD divided by the FQPA SF[c] (a value between 1 and 10), where appropriate.

The noncancer risk estimate is the ratio of the exposure level (expressed as intake of the herbicide in mg/kg-day) to the PAD and is calculated using the following equation:

$$\%PAD = \frac{\text{Food Intake(mg/kg} - \text{day)}}{\text{PAD(mg/kg} - \text{day)}} \times 100$$

Exposures that are less than 100% of the PAD do not exceed the USEPA's level of concern.

As shown in Table B-3, only diflufenzopyr has an acute PAD developed by the USEPA. Chronic PADs are available for diflufenzopyr, diquat, imazapic, and sulfometuron methyl. The FQPA SF for each of these herbicides is 1; therefore, the PAD is equal to the RfD. For fluridone, the USEPA did not provide a PAD; therefore, the oral RfD provided in the USEPA's IRIS database (USEPA 2003c) was used to evaluate chronic oral exposure.

Non-food (MOE) Assessment

This assessment method evaluates exposures via all non-food pathways (e.g., incidental ingestion, dermal, inhalation). The toxicity of the chemical is represented by a NOAEL identified from the scientific literature. The noncancer risk estimate is the ratio of the toxicity value to the exposure level and is calculated using the following general equation:

$$\text{Noncancer,}\quad MOE = \frac{\text{NOAEL(mg/kg} - \text{day)}}{\text{Exposure(mg/kg} - \text{day)}}$$

Target MOEs are derived to account for the uncertainties associated with the NOAEL. Target MOEs are generally set at 100 to account for a factor of 10 for interspecies extrapolation and factor of 10 for intraspecies variability. Additional factors are applied when a LOAEL is used rather than a NOAEL. Calculated MOEs above the target MOE do not exceed the USEPA's level of concern. Calculated MOE values less than the target MOE indicate a potential concern for

human health. As shown in Table B-3, target MOEs are defined for each of the herbicides. Target MOEs are 100 for all herbicides, except for imazapic. The imazapic target MOE for long-term dermal and long-term inhalation exposures is 300, to account for the fact that the toxicity values is based on a LOAEL rather than a NOAEL. For all other exposure routes and time frames, the target MOE is 100.

Aggregate Risk Index

The %PAD method presents the risk result as the exposure estimate divided by the allowable exposure level (the PAD) and is expressed as a percentage of the total allowable exposure. Results less than or equal to 100% of the PAD are considered acceptable. However, for the MOE method, the identified NOAEL is divided by the estimated exposure, and is, therefore, the reverse of the %PAD method. For the MOE method, when the ratio is greater than the target MOE, the risk is considered to be negligible. Risk results using these different methods cannot be directly combined to account for cumulative risk from various exposure pathways. An aggregate approach, described below, is therefore used.

The USEPA's OPP (USEPA 1999a, USEPA 2001b) has developed the Aggregate Risk Index (ARI) approach, which combines potential risks from various pathways expressed as MOEs and %PADs. In this approach, it is important that only exposure pathways encompassing similar exposure durations be combined (i.e., acute exposures cannot be combined with chronic exposures). The ARI is an extension of the MOE concept. The ARI is compared against a target value of one. Values greater than one do not exceed the USEPA's level of concern; values below one indicate a potential concern for human health.

The ARI method allows for direct comparisons between routes and between chemicals. The ARI method considers each route's potency when route-specific NOAELs that may have different target MOEs are used. (Note that USEPA [1999a] designates target MOEs as UFs. This report uses the term target MOEs for consistency with an earlier section, Dose-Response Assessment.) The %PAD calculated for oral exposures can also be incorporated into the ARI approach, using the following equation:

$$ARI = \frac{1}{\%PAD_O + \frac{TM_D}{MOE_D} + \frac{TM_I}{MOE_I}}$$

where:

ARI = Aggregate Risk Index

$\%PAD_O$ = %PAD for oral exposure, expressed as a ratio (i.e., 80% = 0.8)

TM_D = Target MOE for dermal exposure

MOE_D = Site-specific MOE estimated for dermal exposure

TM_I = Target MOE for inhalation exposure

MOE_I = Site-specific MOE estimated for inhalation exposure

Not all herbicides include all of these toxicity endpoints. For example, some herbicides may not be toxic through the dermal route; therefore, the dermal MOE would not be included. The USEPA (1999a) provides the following example for an herbicide and receptor that has a dermal MOE of 100, dermal target MOE of 100, inhalation MOE of 1,000, inhalation target MOE of 300, and an oral %PAD of 80% (expressed as a ratio, 0.8):

$$ARI = \frac{1}{0.8_O + \frac{100_D}{100_D} + \frac{300_I}{1000_I}} = 0.48$$

In this example, the ARI (0.48) suggests a risk of concern because it is less than one. It should be noted that, when listed separately, the oral PAD would be listed as percent oral PAD (in this case, 80%). However, when included in this equation, the actual fraction (not the percentage) is listed.

Therefore, for this HHRA, the %PAD approach has been used to evaluate potential exposures to herbicides in food and water, the MOE approach to evaluate potential exposures to herbicides via non-food and incidental ingestion pathways, and the ARI approach to evaluate combined exposures.

Equations for Quantifying Potential Exposure and Risk

To estimate the potential risk to receptors from exposure to herbicides, it is first necessary to estimate the potential exposure dose of each herbicide. The exposure dose is estimated for each herbicide via each exposure pathway by which the receptor is assumed to be exposed. Exposure dose equations combine the

estimates of herbicide concentration in the environmental medium of interest with assumptions regarding the type and magnitude of each receptor's potential exposure to provide a numerical estimate of the exposure dose. The exposure dose is defined as the amount of herbicide taken into the receptor and is expressed in units of milligrams of herbicide a.i. per kilogram of BW per day. Exposure doses are calculated separately for different time frames, such as short-term, intermediate-term, and long-term exposures.

The standardized equations for estimating a receptor's average daily dose are presented below. The following sections also show whether the dose is used with a NOAEL or PAD to estimate risks. NOAELs are used for non-dietary and incidental ingestion (such as ingestion of water while swimming) pathways to calculate MOEs. Potential risks from dietary exposure (such as drinking water, berry ingestion, and fish ingestion) are estimated using PADs.

Estimating Potential Occupational Exposures

Occupational exposures via dermal contact and inhalation are evaluated using the PHED UE values. For the worker accidental exposure, it is assumed that the worker receives a direct spill and is exposed through dermal contact. The equations used are as follows (additional information is provided for parameters in the equations that have not already been defined).

Dermal Contact with Herbicide

Equations (1) and (2) are used to evaluate occupational exposure through dermal contact.

$$(1)\quad \text{Dose}_{\text{routine}}(\text{mg/kg-day}) = \frac{\text{AR (lb a.i./acre)} * \text{AT (acres/day)} * \text{UE}_{\text{derm}}\text{(mg a.i./lb a.i.)} * \text{DAF(unitless)}}{\text{BW (kg)}}$$

and

$$(2)\quad \text{Dose}_{\text{accident}}(\text{mg/kg-day}) = \frac{\text{S(L/day)} * \text{AC(lb a.i./gallon)} * \text{CF}\left(\frac{\text{mg a.i./L}}{\text{lb a.i./gallon}}\right) * \text{SAR(unitless)} * \text{DAF(unitless)}}{\text{BW (kg)}}$$

where:

Parameter	Units	Definition
AR	lb a.i./acre	Herbicide application rate
AT	acres/day	Acres treated per day
UE_{derm}	mg a.i./lb a.i.	Dermal unit exposure factor
DAF	unitless	Dermal absorption factor
S	L/day	Spill amount = 0.5 L of concentrate
AC	lb a.i./gallon	Concentration of active ingredient in concentrate
CF	1.2E+05 mg a.i./L / lb a.i./gallon	Conversion factor used to convert units of lb a.i. per gallon to units of mg a.i. per liter
SAR	unitless	Surface area ratio = Ratio of surface area exposed to total surface area, expressed as a percent (80% spilled to clothing, with a 30% penetration rate, and 20% spilled to bare skin; [(0.8*0.3)+0.2 = 0.44])
BW	Kg	Body weight

While most UEs are expressed in units of mg a.i./lb a.i., for aquatic application of diquat, the available UEs are in units of mg a.i./hr. The UEs to be used in the risk assessment are those for hydrilla control-applicator and hydrilla control-mixer listed in the RED for diquat (USEPA 1995), which are expressed in terms of mg a.i. per hour. Daily exposure doses for diquat are calculated using equation (3).

Table B-3 lists the short-term, intermediate-term and long-term dermal NOAELs for the six herbicides. There are no dermal NOAELs for diflufenzopyr and sulfometuron methyl because neither have been shown to result in toxicity in response to dermal exposure. Dermal NOAELs are available for the remaining herbicides. Therefore, potential risks were not calculated for the herbicides and specific time frames that lacked dermal NOAELs.

Inhalation of Herbicide

Equation (4) is used to evaluate occupational exposure through inhalation.

$$(3)\ \text{Dose}_{\text{routine}}(\text{mg/kg}-\text{day})=\frac{\text{UE}_{\text{derm}}(\text{mg a.i./hr})*\text{ET(hr/day)}*\text{DAF(unitless)}}{\text{BW (kg)}}$$

where:

Parameter	Units	Definition
ET	hours/day	Exposure time

MOEs are calculated as follows:

Dose	NOAEL Type	MOE Equation
Routine - Dermal	Dermal – short-term (ds)	$\frac{\text{NOAEL}_{\text{ds}}\ (\text{mg / kg} - \text{day})}{\text{Dose}_{\text{routine}}\ (\text{mg / kg} - \text{day})}$
	Dermal – intermediate-term (di)	$\frac{\text{NOAEL}_{\text{di}}\ (\text{mg / kg} - \text{day})}{\text{Dose}_{\text{routine}}\ (\text{mg / kg} - \text{day})}$
	Dermal – long-term (dl)	$\frac{\text{NOAEL}_{\text{dl}}\ (\text{mg / kg} - \text{day})}{\text{Dose}_{\text{routine}}\ (\text{mg / kg} - \text{day})}$
Accident	Dermal – short-term (ds)	$\frac{\text{NOAEL}_{\text{ds}}\ (\text{mg / kg} - \text{day})}{\text{Dose}_{\text{accident}}\ (\text{mg / kg} - \text{day})}$

$$(4)\ \text{Dose}_{\text{routine}}(\text{mg / kg}-\text{day})=\frac{\text{AR (lb a.i. / acre)}*\text{AT (acres / day)}*\text{UE}_{\text{inh}}(\text{mg a.i. / lb a.i.})*\text{IAF(unitless)}}{\text{BW (kg)}}$$

where:

Parameter	Units	Definition
AR	lb a.i./acre	Herbicide application rate
AT	acres/day	Acres treated
UE_{inh}	mg a.i./lb a.i.	Inhalation unit exposure from PHED database
IAF	unitless	Inhalation absorption factor
BW	kg	Body weight

MOEs are calculated as follows:

Dose	NOAEL Type	MOE Equation
Routine	Inhalation – short-term (is)	$\frac{NOAEL_{is}\ (mg/kg-day)}{Dose_{routine}\ (mg/kg-day)}$
	Inhalation – intermediate-term (ii)	$\frac{NOAEL_{ii}\ (mg/kg-day)}{Dose_{routine}\ (mg/kg-day)}$
	Inhalation – long-term (il)	$\frac{NOAEL_{il}\ (mg/kg-day)}{Dose_{routine}\ (mg/kg-day)}$

Table B-3 lists the short-term, intermediate-term, and long-term inhalation NOAELs for the six herbicide active ingredients. Inhalation NOAELs are available for all of the herbicides and time frames, which are reflected in the risk calculations.

Estimating Potential Exposure for Public Receptors

Exposure assumptions for public receptors are presented in Table B-4 to B-9. The equations used to calculate exposure doses are shown below. Additional information is provided for parameters in the equations that have not already been defined. As discussed earlier, dose-response values are available for short, intermediate, and long-term exposures. While it is possible that public receptors use public lands under intermediate- and long-term time frames, it is unlikely that public receptors would be exposed to herbicides under the routine use scenario for more than a short-term exposure, which is defined as 1 day to 1 month (USEPA 2001h). Therefore, short-term dose-response values are used to evaluate the public receptors under the routine use exposure scenario. To account for the unlikely possibility that public receptors could repeatedly enter areas that have been recently sprayed, the Uncertainty Analysis includes an evaluation of the public receptors under an intermediate and a long-term exposure scenario.

Dermal Contact with Herbicide.

Equations (5) and (6) are used to evaluate dermal contact with herbicides for public receptors through spray drift and accidental direct spray.

Spray Drift

(5) $Dose_{routine}\ (mg/kg-day) = EF_{dp}\ (cm^2/kg-day) * DR\ (mg\ a.i./cm^2) * DAF\ (unitless)$

Direct Spray

(6)

$$Dose_{accident}\ (mg/kg-day) = EF_{dp}\ (cm^2/kg-day) * AR\ (lb\ a.i./acre) * CF_1\ (mg/lb) * CF_2\ (acre/cm^2) * DAF\ (unitless)$$

where:

$$EF_{dp}\ (cm^2/kg-day) = \frac{SA\ (cm^2/day)}{BW\ (kg)}$$

and where:

Parameter	Units	Definition
EF_{dp}	cm^2/kg-day	Exposure factor for dermal pathway
AR	lb a.i./acre	Herbicide application rate, direct spray, accidental scenarios
DR	mg a.i./cm^2	Herbicide deposition rate due to spray drift
CF_1	4.54×10^5 mg/lb	Conversion factor used to convert pounds to mg
CF_2	2.47×10^{-8} acre/cm^2	Conversion factor used to convert acres to cm^2
DAF	Unitless	Dermal absorption factor
SA	cm^2/day	Surface area of skin exposed
BW	kg	Body weight

MOEs are calculated as follows:

Dose	NOAEL Type	MOE Equation
Routine	Dermal – short-term (ds)	$\frac{NOAEL_{ds}\ (mg/kg-day)}{Dose_{routine}\ (mg/kg-day)}$
Accident	Dermal – short-term (ds)	$\frac{NOAEL_{ds}\ (mg/kg-day)}{Dose_{accident}\ (mg/kg-day)}$

The short-term dermal NOAELs are presented in Table B-3. Note that two of the herbicides, diflufenzopyr and sulfometuron methyl, have been identified as not inducing dermal toxicity; therefore, dermal MOEs are not calculated for these herbicides. For certain herbicides, the dose is calculated by including a DAF in the numerator of the equation to account for dermal absorption when the endpoint is selected from an oral study. The calculation of dermal doses for diquat, fluridone, and imazapic include DAFs of 4.1%, 40%, and 50%, since the dermal NOAELs are based on oral studies. For the other herbicides, the USEPA has determined that dermal absorption is insignificant or that the dermal NOAELs are based on dermal studies and a DAF is not required.

Dermal Contact with Foliage

It is assumed that recreational and residential receptors could be exposed through dermal contact with herbicides present on foliage while hiking or berry picking. The equations for this pathway are based on information provided in two documents:

- Draft Standard Operating Procedures (SOPs) for Residential Exposure Assessments (USEPA 1997d)
- Occupational and Residential Exposure and Risk for the Proposed Use of Metsulfuron-Methyl on Sorghum (USEPA 2002c)

Equation (7) is used to quantify this potential exposure is as follows:

$$(7)\ Dose\ (mg/kg-day) = EF_{df}\ (cm^2/kg-day) * DFR\ (mg/cm^2) * DAF$$

where:

$$EF_{df}\ (cm^2/kg-day) = \frac{T_c\ (cm^2/hr) * ET\ (hr/day)}{BW\ (kg)}$$

$$DFR_{routine}\ (mg/cm^2) = DR\ (mg\ a.i./cm^2) * F\ (unitless)$$

$$DFR_{accident}\ (mg/cm^2) = F\ (unitless) * AR\ (lb\ a.i./acre) * CF_1\ (mg/lb) * CF_2\ (acre/cm^2)$$

and where:

Parameter	Units	Definition
EF_{df}	cm^2/kg-day	Exposure factor for dermal foliage pathway
DFR	mg/cm^2	Dislodgeable foliar residue (calculated)
T_c	cm^2/hr	Transfer coefficient (described below)
ET	hr/day	Exposure time
BW	kg	Body weight
DR	mg a.i./cm^2	Herbicide deposition rate due to spray drift
F	unitless	Fraction active ingredient retained on foliage (described below)
AR	lb a.i./acre	Herbicide application rate direct spray, accidental scenario
CF_1	$4.54x10^5$ mg/lb	Conversion factor used to convert pounds to mg
CF_2	$2.47x10^{-8}$ acre/cm^2	Conversion factor used to convert acres to cm^2

MOEs are calculated as follows:

Dose	NOAEL Type	MOE Equation
Routine	Dermal – short-term (ds)	$\frac{NOAEL_{ds}\,(mg/kg-day)}{Dose_{routine}\,(mg/kg-day)}$
Accident	Dermal – short-term (ds)	$\frac{NOAEL_{ds}\,(mg/kg-day)}{Dose_{accident}\,(mg/kg-day)}$

The short-term dermal NOAELs are presented in Table B-3. Note that two of the herbicides, diflufenzopyr and sulfometuron methyl, have been identified as not inducing dermal toxicity, therefore, dermal MOEs are not calculated for these herbicides. For certain herbicides, the dose is calculated by including a DAF in the numerator of the equation to account for dermal absorption when the endpoint is selected from an oral study. The calculation of dermal doses for diquat, fluridone, and imazapic include DAFs of 4.1%, 40%, and 50%, since the dermal NOAELs are based on oral studies. For the other herbicides, the USEPA has either determined that dermal absorption is insignificant, or the dermal NOAELs are based on dermal studies and a DAF factor is not required.

The dermal Tc is used to estimate the amount of herbicide that may be transferred from foliage to skin. Transfer coefficients for each receptor were selected as follows:

- Hiker/hunter and angler - 1,000 cm^2/hour (155 in^2/hour; the central tendency Tc value for scouting grapes and also for scouting sweet corn, and recommended as a surrogate for scouting activity for berries) from USEPA 2000b (referenced by USEPA 2002c)
- Adult berry picker - 1,500 cm^2/hour (233 in^2/hour; the high end blueberry value) from USEPA 2000b (referenced by USEPA 2002c)
- Child berry picker - 300 cm^2/hour (47 in^2/hour), based on the child to adult SAR (CalEPA 1996)
- Residential adult – 14,500 cm^2/hour (2,248 in^2/hour; USEPA 2001k)
- Residential child – 5,200 cm^2/hour (806 in^2/hour; USEPA 2001k)
- Native American adult – 1,500 cm^2/hour (233 in^2/hour; the high end blueberry value) from USEPA 2000b (referenced by USEPA 2002c)
- Native American child – 300 cm^2/hour (47 in^2/hour), based on the child to adult SAR (CalEPA 1996)

The fraction of a.i. retained on foliage is assumed to be 20%. This is the fraction assumed to be present on foliage on the day of application (USEPA 1997d). This value is based on the professional judgment and experience of USEPA staff, and is assumed to represent an upper-percentile value.

Dermal Contact with Water While Swimming

Equation (8) used to estimate a receptor's potential exposure via dermal contact with surface water is as follows:

$$(8)\ \text{Dose}\ (\text{mg/kg}-\text{day}) = EF_{dw}\ (\text{cm}^2-\text{hr/kg}-\text{day}) * Kp\,(\text{cm/hr}) * C_w\ (\text{mg a.i./L}) * CF_3\ (\text{L/cm}^3)$$

where:

$$EF_{dw}\ (\text{cm}^2-\text{hr/kg}-\text{day}) = \frac{SA\ (\text{cm}^2) * ET(\text{hr/day})}{BW(\text{kg})}$$

and where:

Parameter	Units	Definition
EF_{dw}	cm^2-hr/kg-day	Exposure factor for dermal water pathway
Kp	cm/hr	Permeability constant for skin
C_w	mg a.i./L	Concentration in water
CF_3	L/1,000 cm^3	Conversion factor used to convert liters to cm^3
SA	cm^2	Surface area of skin exposed
BW	kg	Body weight

MOEs are calculated as follows:

Dose	NOAEL Type (a)	MOE Equation
Routine	Oral – short/intermediate-term (o)	$\frac{NOAEL_o\ (\text{mg/kg}-\text{day})}{Dose_{routine}\ (\text{mg/kg}-\text{day})}$
Accident	Oral – short/intermediate-term (o)	$\frac{NOAEL_o\ (\text{mg/kg}-\text{day})}{Dose_{accident}\ (\text{mg/kg}-\text{day})}$

The short-term water concentration is used with the short- and intermediate-term NOAEL to derive an MOE for short-term exposure. Water concentrations for the accidental scenarios are used with the short- and intermediate-term NOAELs to derive MOEs for the accidental scenarios. As discussed previously, the intermediate- and long-term exposure scenario is evaluated in the Uncertainty Analysis.

The accidental spill scenario assumes that 140 gallons of herbicide mix from a helicopter or 200 gallons of herbicide mix from a batch truck are spilled. These amounts are approximately the largest amounts used by the BLM that can be carried in helicopters or trucks, respectively. The pond is assumed to be ¼ acre in size and 1 meter in depth.

Oral NOAELs are used to evaluate the dermal contact with water pathway because the dermal dose in the equation assumes that the herbicide is absorbed into the body. Dermal NOAELs assume that the dose is applied to the skin and that the skin acts as a barrier. Therefore, use of dermal NOAELs with an absorbed dose may result in an underestimation of the amount of herbicide absorbed. Although oral NOAELs have not necessarily been adjusted to reflect an absorbed dose, absorption of these herbicides is assumed to be much higher via the oral exposure route than the dermal exposure route. Therefore, it is more appropriate to use oral NOAELs for the dermal contact with water pathway. Table B-3 lists the short- and intermediate-term oral NOAELs for each of the herbicides.

Ingestion of Drinking Water or Swimming Water

The equation used to estimate a receptor's potential exposure via ingestion of drinking water or swimming water is as follows:

$$\text{Dose}\,(\text{mg}/\text{kg}-\text{day}) = EF_{iw}\,(\text{L}/\text{kg}-\text{day}) * C_w\,(\text{mg}/\text{L})$$

where:

$$EF_{iw}\,(\text{L}/\text{kg}-\text{day}) = \frac{IR_w\,(\text{L}/\text{day})}{BW\,(\text{kg})}$$

and where:

Parameter	Units	Definition
EF_{iw}	L/kg-day	Exposure factor for ingestion of water pathway
C_w	mg/L	Concentration in water
IR_w	L/day	Ingestion Rate for water
BW	kg	Body Weight

For incidental ingestion pathways (swimmer), the risk assessment uses the oral NOAELs to calculate MOEs. Oral NOAELs are used rather than PADs because this ingestion is considered incidental rather than dietary. MOEs are calculated as follows:

Dose	NOAEL Type	MOE Equation (Incidental Ingestion)
Routine	Oral – short/intermediate-term (o)	$\frac{NOAEL_o\,(\text{mg}/\text{kg}-\text{day})}{Dose_{routine}\,(\text{mg}/\text{kg}-\text{day})}$
Accident	Oral – short/intermediate-term (o)	$\frac{NOAEL_o\,(\text{mg}/\text{kg}-\text{day})}{Dose_{accident}\,(\text{mg}/\text{kg}-\text{day})}$

Table B-3 lists the short- and intermediate-term oral NOAELs for each of the herbicides. For drinking water pathways (hiker/hunter, berry picker, angler, and Native American), it is more relevant to compare the dose with a PAD and calculate a %PAD. The drinking water pathway represents dietary exposure. The PADs are calculated as follows:

Dose	PAD Type	%PAD Equation (Drinking Water)
Routine	Acute PAD	$\frac{Dose_{routine}\,(\text{mg}/\text{kg}-\text{day})}{PAD_{chronic}\,(\text{mg}/\text{kg}-\text{day})} * 100\%$
Accident	Acute PAD	$\frac{Dose_{accident}\,(\text{mg}/\text{kg}-\text{day})}{PAD_{acute}\,(\text{mg}/\text{kg}-\text{day})} * 100\%$

Table B-3 lists acute and chronic PADs for the six herbicides. The acute PAD was used for the accidental and short-term routine exposure scenarios. The USEPA has developed an acute PAD only for diflufenzopyr and diquat. Chronic PADs are available for all six herbicides.

Concentrations in water due to spray drift and runoff are calculated for short-, intermediate-, and long-term exposure. As discussed previously, the intermediate- and long-term exposure scenarios are evaluated in the uncertainty analysis. The short-term water concentration is used with the short- and intermediate-term NOAEL to derive an MOE for short-term swimming exposure and with the acute PAD to derive a %PAD for the short-term drinking water pathway. Water concentrations are used with the short/intermediate-term NOAELs to derive MOEs for the accidental swimming scenarios and with the acute PADs to derive %PADs for the accidental drinking water scenarios.

Ingestion of Fish

A recreational angler may ingest fish that have bioaccumulated herbicides present in surface water. The equation used to estimate a receptor's potential exposure via fish ingestion is as follows:

$$\text{Dose}\,(\text{mg/kg}-\text{day}) = EF_{fi}\,(\text{mg/kg}-\text{day}) * C_w\,(\text{mg/L}) * BCF\,(\text{L/kg}) * CF_4\,(\text{kg/mg})$$

where:

$$EF_{fi}\,(\text{mg/kg}-\text{day}) = \frac{IR_f\,(\text{mg/day})}{BW(\text{kg})}$$

and where:

Parameter	Units	Definition
EF_{fi}	mg/kg-day	Exposure factor for fish ingestion pathway
C_w	mg/L	Concentration in water
BCF	L/kg	Bioconcentration factor
CF_4	10^{-6} kg/mg	Conversion factor used to convert mg to kg
IR_f	mg/day	Ingestion rate for fish
BW	kg	Body weight

PADs are calculated as follows:

Dose	PAD Type	%PAD Equation
Routine	Acute PAD	$\frac{\text{Dose}_{routine}\,(\text{mg/kg}-\text{day})}{\text{PAD}_{chronic}\,(\text{mg/kg}-\text{day})} * 100\%$
Accident	Acute PAD	$\frac{\text{Dose}_{accident}\,(\text{mg/kg}-\text{day})}{\text{PAD}_{acute}\,(\text{mg/kg}-\text{day})} * 100\%$

The BCF is defined as the ratio of chemical concentration in the organism to that in surrounding water. Bioconcentration occurs through uptake and retention of a substance from water only, and through gill membranes or other external body surfaces. The BCFs for each of the herbicides have been estimated using information from the literature.

Concentrations in water are calculated for short-, intermediate-, and long-term exposures due to spray drift and runoff. As discussed previously, the intermediate and long-term exposure scenarios are evaluated in the Uncertainty Analysis. The short-term water concentration is used with the acute PAD to derive a %PAD for short-term exposure. Water concentrations are used with the acute PADs to derive %PADs for the accidental scenarios.

Ingestion of Berries

It is assumed that several receptors (berry picker, nearby resident, and Native American) could be exposed to herbicides through berry ingestion. None of the USEPA pesticide documents specifically list an equation for evaluating berry or other food ingestion. However, USEPA (2002c) provides an equation for a pathway involving toddler ingestion of pesticide-treated grass. This equation was used to evaluate ingestion of berries:

$$\text{Dose}\,(\text{mg/kg}-\text{day}) = BR\,(\text{mg/cm}^2) * EF_{bi}\,(\text{cm}^2/\text{kg}-\text{day})$$

where:

$$EF_{bi}\ (cm^2/kg-day) = \frac{IR_b\ (cm^2/day)}{BW\ (kg)}$$

$$BR_{routine}\ (mg/cm^2) = DR\ (mg/cm^2) * F$$

$$BR_{accident}\ (mg/cm^2) = AR\ (lb\ a.i./acre) * F * CF_1\ (mg/lb) * CF_2\ (acre/cm^2)$$

and where:

Parameter	Units	Definition
EF_{bi}	cm^2/kg-day	Exposure factor for berry ingestion pathway
IR_b	cm^2/day	Ingestion rate for berries
BW	kg	Body weight
BR	mg/cm^2	Berry residue (calculated)
DR	mg/cm^2	Herbicide deposition rate due to spray drift
F	unitless	Fraction of a.i. available on berry (discussed below)
AR	lb a.i./acre	Herbicide application rate, direct spray accidental scenarios
CF_1	4.54×10^5 mg/lb	Conversion factor to convert pounds to mg
CF_2	2.47×10^{-8} acre/cm^2	Conversion factor to convert acres to cm^2

PADs are calculated as follows:

Dose	PAD Type	%PAD Equation
Routine	Acute PAD	$\frac{Dose_{routine}\ (mg/kg-day)}{PAD_{chronic}\ (mg/kg-day)} * 100\%$
Accident	Acute PAD	$\frac{Dose_{accident}\ (mg/kg-day)}{PAD_{acute}\ (mg/kg-day)} * 100\%$

The equation presented in USEPA (2002c) for toddler grass ingestion uses an IR of 25 cm^2/day assuming that a child eats a handful of grass (2 inch x 2 inch). Therefore, it was necessary to convert the berry IR in units of mg/day to a berry IR in units of cm^2/day. The conversion required SA (cm^2) to weight (mg) of berry ratio. Cheung and Yen (1996) calculated a SA to weight ratio of 2 cm^2/g for Thompson Seedless grapes. This value was used to estimate the berry IR in units of cm^2/day. It was assumed that herbicides deposit only on the top half of a berry. Therefore, half of the SA was used in the equation. The following equation was used to convert the berry IR from units of mg/day to units of cm^2/day:

$$\text{Ingestion rate}\ (cm^2/day) = [\text{Ingestion rate}\ (mg/day)] * [1\ g/1000\ mg] * [2\ cm^2/g] * 0.5$$

The fraction a.i. retained on the berry (F) is assumed to be 20%, similar to the assumption for foliage. This is the fraction assumed to be present on foliage on the day of application (USEPA 1997d). As stated in USEPA (1997d), this value is based on the professional judgment and experience of USEPA staff, and is assumed to represent an upper-percentile value.

Results of Risk Characterization

Using the equations provided above, %PADs and MOEs were calculated for each of the herbicide active ingredients for individual receptors. Some of the herbicides lacked specific PADs and NOAELs; therefore, it was not possible to conduct risk

calculations for all exposure pathways and herbicides. For the accidental scenarios, it was assumed that a receptor is exposed to one accidental exposure pathway; therefore, the accidental risks from different scenarios were not added together. For the routine-use scenarios, it was assumed that a receptor could be exposed to a specific herbicide through several exposure pathways. Therefore, ARIs were calculated for routine-use scenarios. The risk characterization results for the occupational and public receptors are discussed separately. Table B-10 shows the generalized risk level (low, medium, high) that each application scenario for each chemical presents to each receptor.

Occupational Receptors

For the occupational receptors, separate calculations were conducted for routine-use typical AR scenarios, routine-use maximum AR scenarios, and accidental scenarios. For the routine-use scenarios, exposure through dermal and inhalation exposures was evaluated (if appropriate information was available for the specific herbicide). In the current USEPA OPP program, short-term is defined as 1 day to 1 month, intermediate-term is defined as 1 to 6 months, and long-term is defined as greater than 6 months (USEPA 2001h). The accidental scenario evaluated exposure through dermal absorption. The results for each herbicide are summarized below.

Dicamba

Dicamba is proposed for use on rangeland, energy and mineral sites, ROW, and recreation and cultural sites. Dicamba may be applied using the following methods: truck (boom/broadcast or spot applications), ATV (boom/broadcast or spot applications), horseback (spot applications), and backpack (spot applications). Therefore, potential occupational receptors include an applicator, a mixer/loader, and a combined applicator/mixer/loader.

Routine use ARIs were calculated for inhalation and dermal exposures under both typical and maximum AR scenarios. Routine use ARIs are greater than 1 under both the typical and maximum AR scenarios, indicating no exceedance of the USEPA's level of concern (Table B-11).

Under the accidental scenario, it is assumed that dicamba is spilled directly onto an occupational receptor. Because dicamba is provided by the manufacturer in granular form, it cannot be spilled as a concentrated liquid. Therefore, under the accidental scenario, it is assumed that dicamba is spilled on the skin after it has been mixed at the maximum AR concentration. The ARIs for the accidental scenario (maximum AR) for all occupational receptors are less than 1, indicating a level of concern. Because of the conservative nature of the scenario, ARIs were also calculated assuming a spill to worker skin at the typical AR, and these ARIs are also below 1, indicating a level of concern.

These results show that dicamba risks exceed the USEPA's level of concern for all of the occupational receptors under the accidental scenario evaluated, but not under the routine use scenario.

Diflufenzopyr

Diflufenzopyr is proposed for use on energy and mineral sites, ROW, and recreation and cultural sites. Diflufenzopyr may be applied using the following methods: truck (boom/broadcast or spot applications), ATV (boom/broadcast or spot applications), and backpack (spot applications). Diflufenzopyr may also be applied via horseback in recreation and cultural sites. Therefore, potential occupational receptors include an applicator, a mixer/loader, and a combined applicator/mixer/loader.

Routine use ARIs were calculated for inhalation exposures under both typical and maximum AR scenarios. No dermal toxicity values are available for diflufenzopyr, which, based on laboratory data, is not expected to be toxic through the dermal route. Routine use ARIs are greater than 1 under both the typical and maximum AR scenarios, indicating no exceedance of the USEPA's level of concern.

Under the accidental scenario, it is assumed that diflufenzopyr is spilled directly onto an occupational receptor. Because diflufenzopyr is provided by the manufacturer in granular form, it cannot be spilled as a concentrated liquid. Therefore, under the accidental scenario, it is assumed that diflufenzopyr is spilled on the skin after it has been mixed at the maximum AR concentration. However, based on laboratory data, diflufenzopyr is not expected to be toxic through the dermal route and therefore does not have a short-term dermal NOAEL. Therefore, while spill concentrations were calculated, an accidental scenario ARI was not calculated.

These results show that diflufenzopyr risks do not exceed the USEPA's level of concern for any of the occupational receptors under the scenarios evaluated.

Diquat

Diquat is proposed for use on aquatic sites. Diquat may be applied using the following methods: airplane, helicopter, truck (boom/broadcast or spot applications), ATV (boom/broadcast or spot applications), boat (boom/broadcast or spot applications), horseback (spot applications), and backpack (spot applications). Therefore, potential occupational receptors include pilots, applicators, mixer/loaders, and combined applicator/mixer/loaders.

Routine use ARIs were calculated for dermal and inhalation exposures under both typical and maximum AR scenarios. Inhalation UEs are not applicable to the boat scenario. Therefore, long-term ARIs were not calculated for the boat scenario. Under the typical AR scenario, ARIs are less than 1 for the following scenarios, indicating a level of concern:

- Airplane pilot (short-, intermediate-, and long-term exposure)
- Airplane mixer/loader (short-, intermediate-, and long-term exposure)
- Helicopter pilot (short-, intermediate-, and long-term exposure)
- Helicopter mixer/loader (short-, intermediate-, and long-term exposure)
- Backpack applicator/mixer/loader (short-, intermediate-, and long-term exposure)
- Horseback applicator (short-, intermediate-, and long-term exposure)
- Horseback applicator/mixer/loader (short-, intermediate-, and long-term exposure)

Under the maximum AR scenario, ARIs are less than 1 for the following scenarios, indicating a level of concern:

- Airplane pilot (short-, intermediate-, and long-term exposure)
- Airplane mixer/loader (short-, intermediate-, and long-term exposure)
- Helicopter pilot (short-, intermediate-, and long-term exposure)
- Helicopter mixer/loader (short-, intermediate-, and long-term exposure)
- Backpack applicator/mixer/loader (short-, intermediate-, and long-term exposure)
- Horseback applicator (short-, intermediate-, and long-term exposure)
- Horseback mixer/loader (short-, intermediate-, and long-term exposure)
- Horseback applicator/mixer/loader (short-, intermediate-, and long-term exposure)
- ATV spot applicator (short-, intermediate-, and long-term exposure)
- ATV spot applicator/mixer/loader (short-, intermediate-, and long-term exposure)
- ATV boom/broadcast applicator (short-, intermediate-, and long-term exposure)
- ATV boom/broadcast mixer/loader (short-, intermediate-, and long-term exposure)
- ATV boom/broadcast applicator/mixer/loader (short-, intermediate-, and long-term exposure)
- Truck mount spot applicator (short-, intermediate-, and long-term exposure)
- Truck mount spot mixer/loader (short-, intermediate-, and long-term exposure)
- Truck mount spot applicator/mixer/loader (short-, intermediate-, and long-term exposure)
- Truck mount boom/broadcast applicator (short-, intermediate-, and long-term exposure)
- Truck mount boom/broadcast mixer/loader (short-, intermediate-, and long-term exposure)
- Truck mount boom/broadcast applicator/mixer/loader (short-, intermediate-, and long-term exposure)

All application scenarios for diquat require the use of gloves. Diquat is provided by the manufacturer in liquid form. Therefore, accidental scenario ARIs were calculated assuming the concentrated herbicide is spilled directly onto an occupational receptor. The ARIs for the accidental scenario (concentrated liquid) for all occupational receptors are less than 1, indicating a level of concern. Because of the conservative nature of the scenario (i.e., a spill of concentrated liquid directly to worker skin), ARIs were also calculated assuming a spill to worker skin after at the maximum and typical ARs. The ARIs, assuming a spill of diquat solution under both the typical and maximum ARs, are below 1, indicating a level of concern.

These results show that diquat risks exceed the USEPA's level of concern for the occupational

receptors under the majority of terrestrial scenarios evaluated, as listed above.

Fluridone

Fluridone is proposed for use on aquatic sites. Fluridone may be applied using the following methods: airplane, helicopter, truck (boom/broadcast or spot applications), ATV (boom/broadcast or spot applications), boat (boom/broadcast or spot applications), horseback (spot applications), and backpack (spot applications).

Therefore, potential occupational receptors include pilots, applicators, mixer/loaders, and combined applicator/mixer/loaders.

Routine use ARIs were calculated for dermal and inhalation exposures under both typical and maximum AR scenarios. Routine use ARIs are greater than 1 for the typical AR scenarios, indicating no exceedance of the USEPA's level of concern. Under the maximum AR scenario, ARIs are less than 1 for the following scenarios, indicating a level of concern:

- Airplane mixer/loader (intermediate- and long-term exposure)
- Helicopter mixer/loader (long-term exposure)

Fluridone is provided by the manufacturer in liquid form. Therefore, accidental scenario ARIs were calculated assuming the concentrated herbicide is spilled directly onto an occupational receptor. The ARIs for the accidental scenario for all occupational receptors are less than 1, indicating a level of concern. Because of the conservative nature of the scenario (i.e., a spill of concentrated liquid directly to worker skin), ARIs were also calculated assuming a spill to worker skin after at the maximum and typical ARs. The ARIs, assuming a spill of fluridone solution under both the typical and maximum ARs, are below 1, indicating a level of concern.

These results show that fluridone risks could exceed USEPA's level of concern for all occupational receptors under the accidental scenario, for the airplane mixer/loader under the routine use (maximum AR) scenario for intermediate- and long-term exposures, and for the helicopter mixer/loader under the routine use (maximum AR) scenario for long-term exposures.

Imazapic

Imazapic is proposed for use on rangeland, public-domain forestland, energy and mineral sites, ROW, and recreation and cultural sites. Imazapic may be applied using the following methods: airplane, helicopter, truck (boom/broadcast or spot applications), ATV (boom/broadcast or spot applications), horseback (spot applications), and backpack (spot applications). Therefore, potential occupational receptors include pilots, applicators, mixer/loaders, and combined applicator/mixer/loaders.

Routine use ARIs were calculated for dermal and inhalation exposures under both typical and maximum AR scenarios. No short or intermediate-term dermal NOAELs are available for imazapic as dermal toxicity tests were negative even at high doses. Therefore, the short and intermediate-term ARIs are based on the inhalation pathway, and the long-term ARI is based on both the dermal and inhalation pathways. Routine use ARIs are greater than 1 under both the typical and maximum AR scenarios, indicating no level of concern.

Imazapic is provided by the manufacturer in liquid form. Therefore, under the accidental scenario, it was assumed that the concentrated herbicide is spilled directly onto an occupational receptor. However, imazapic has not been shown to be toxic via short-term exposures via the dermal route, and no NOAELs have been identified. Therefore, while spill concentrations were calculated, an accidental scenario ARI was not calculated.

These results show that imazapic risks are not expected to exceed the USEPA's level of concern for any of the occupational receptors under the scenarios evaluated.

Sulfometuron Methyl

Sulfometuron methyl is proposed for use on public-domain forestland, energy and mineral sites, ROW, and recreation and cultural sites. Sulfometuron methyl may be applied using the following methods: helicopter, truck (boom/broadcast or spot applications), ATV (boom/broadcast or spot applications), horseback (spot applications), and backpack (spot applications); however, helicopter applications would not occur on recreation and cultural sites. Therefore, potential occupational receptors include pilots, applicators, mixer/loaders, and combined applicator/mixer/loaders.

Routine use ARIs were calculated for dermal and inhalation exposures under both typical and maximum AR scenarios. Routine use ARIs are greater than 1 under both the typical and maximum AR scenarios, indicating no level of concern.

TABLE B-10
Summary of Herbicide Risk Categories by Aggregate Risk Index

	Dicamba			Diflufenzopyr			Diquat			Fluridone			Imazapic			Sulfometuron Methyl		
	Typ[1]	Max	Accid	Typ	Max	Accid	Typ	Max	Accid	Typ	Max	Accid[2]	Typ	Max	Accid	Typ	Max	Accid
Occupational Receptor																		
Plane – pilot	NE[3]	NE	NE	NE	NE	NE	L	M	H	0	0	L-H	0	0	NE	0	0	NE
Plane - mixer/loader	NE	NE	NE	NE	NE	NE	M	H	H	0	L [2:3]	L-H	0	0	NE	0	0	NE
Helicopter – pilot	NE	NE	NE	NE	NE	NE	L	M	H	0	0	L-H	0	0	NE	0	0	NE
Helicopter - mixer/loader	NE	NE	NE	NE	NE	NE	M	H	H	0	L [1:3]	L-H	0	0	NE	0	0	NE
Human/backpack - applicator/mixer/loader	0	0	L	0	0	NE	L	M	H	0	0	L-H	0	0	NE	0	0	NE
Human/horseback – applicator	0	0	L	0	0	NE	L	L	H	0	0	L-H	0	0	NE	0	0	NE
Human/horseback - mixer/loader	0	0	L	0	0	NE	0	L	H	0	0	L-H	0	0	NE	0	0	NE
Human/horseback - applicator/mixer/loader	0	0	L	0	0	NE	L	M	H	0	0	L-H	0	0	NE	0	0	NE
ATV – applicator[4]	0	0	L	0	0	NE	0	L	H	0	0	L-H	0	0	NE	0	0	NE
ATV - mixer/loader	0	0	L	0	0	NE	0	L	H	0	0	L-H	0	0	NE	0	0	NE
ATV - applicator/mixer/loader	0	0	L	0	0	NE	0	L	H	0	0	L-H	0	0	NE	0	0	NE
Truck – applicator	0	0	L	0	0	NE	0	M	H	0	0	L-H	0	0	NE	0	0	NE
Truck - mixer/loader	0	0	L	0	0	NE	0	L	H	0	0	L-H	0	0	NE	0	0	NE
Truck - applicator/mixer/loader	0	0	L	0	0	NE	0	M	H	0	0	L-H	0	0	NE	0	0	NE
Boat – applicator	NE	NE	NE	NE	NE	NE	0	0	H	0	0	L-H	NE	NE	NE	NE	NE	NE
Boat - mixer/loader	NE	NE	NE	NE	NE	NE	0	0	H	0	0	L-H	NE	NE	NE	NE	NE	NE
Boat - applicator/mixer/loader	NE	NE	NE	NE	NE	NE	0	0	H	0	0	L-H	NE	NE	NE	NE	NE	NE

TABLE B-10 (Cont.)
Summary of Herbicide Risk Categories by Aggregate Risk Index

	Dicamba			Diflufenzopyr			Diquat			Fluridone			Imazapic			Sulfometuron Methyl		
	Typ	Max	Accid	Typ	Max	Accid	Typ	Max	Accid	Typ	Max	Accid[1]	Typ	Max	Accid	Typ	Max	Accid
Public Receptor																		
Hiker/hunter (adult)	0	0	0	0	0	0	0	L [2:4]	L [2:5] M [1:5]	0	0	0	NE	NE	NE	NE	NE	NE
Berry picker (child)	0	0	0	0	0	0	0	L [2:4]	L [3:6] M [1:6]	0	0	L [1:2]	NE	NE	NE	NE	NE	NE
Berry picker (adult)	0	0	0	0	0	0	0	L [2:4]	L [2:6] M [1:6]	0	0	0	NE	NE	NE	NE	NE	NE
Angler (adult)	0	0	0	0	0	0	0	L [2:4]	L [2:8] M[1:8]	0	0	0	NE	NE	NE	NE	NE	NE
Residential (child)	0	0	0	0	0	0	L [2:4]	L [2:4]	M [2:3]	0	0	L	NE	NE	NE	NE	NE	NE
Residential (adult)	0	0	0	0	0	0	0	L [2:4]	M [2:3]	0	0	0	0	0	0	0	0	0
Native American (child)	0	0	0	0	0	0	0	L [2:4]	L [2:12] M[1:12]	0	0	L [1:5]	0	0	0	0	0	0
Native American (adult)	0	0	0	0	0	0	0	L [2:4]	L [1:12] M[1:12]	0	0	0	0	0	0	0	0	0
Swimmer (child)	0	0	0	0	0	0	0	0	L [1:3] M [1:3]	0	0	0	0	0	0	0	0	0
Swimmer (adult)	0	0	0	0	0	0	0	0	L [2:3]	0	0	0	0	0	0	0	0	0

[1] Typ = Typical application rate; Max = Maximum application rate; and Accid = Accidental application rate.

[2] For all occupational receptors accidentally exposed to fluridone, there is low risk from exposure to solutions mixed with water to the typical application rate, moderate risk from exposure to solutions mixed with water to the maximum application rate, and high risk from exposure to concentrated solutions (prior to mixing with water).

[3] Risk categories: 0 = No Risk (ARI>1); L = Low Risk (1>ARI>0.1); M = Moderate Risk (0.1>ARI>0.01); H = High Risk (ARI<0.01); and NE = Not evaluated. Typical and maximum application rate categories for occupational scenarios include short-, intermediate-, and long-term exposures. For public receptors, only short-term exposures were evaluated. Accidental scenario category includes accidents with herbicide mixed at both typical and maximum application rates and with concentrated herbicide. Numbers in brackets represent the number of times the Aggregate Risk Index (ARI) values fell within the indicated Risk Category compared to the number of scenarios evaluated for that receptor. If there are no brackets, the Risk Category was consistent for all exposure scenarios for that receptor.

[4] ATV and Truck categories include spot and boom/broadcast application scenarios.

TABLE B-11
Occupational Scenarios with Aggregate Risk Indices Below One[1]

Application Type	Application Vehicle	Application Method	Receptor	Typical Application Rate Scenario ARIs			Maximum Application Rate Scenario ARIs			Accidental Scenario ARIs[2]
				Short-Term	Intermediate-Term	Long-Term	Short-Term	Intermediate-Term	Long-Term	Short-Term (Dermal)
Aerial	Plane	Fixed wing	Pilot	Diquat	Diquat	Diquat	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone
Aerial	Plane	Fixed wing	Mixer/loader	Diquat	Diquat	Diquat	Diquat	Diquat, fluridone	Diquat, fluridone	Dicamba, diquat, fluridone
Aerial	Helicopter	Rotary	Pilot	Diquat	Diquat	Diquat	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone
Aerial	Helicopter	Rotary	Mixer/loader	Diquat	Diquat	Diquat	Diquat	Diquat	Diquat, fluridone	Dicamba, diquat, fluridone
Ground	Human	Backpack	Applicator/ Mixer/loader	Diquat	Diquat	Diquat	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone
Ground	Human	Horseback	Applicator	Diquat	Diquat	Diquat	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone
Ground	Human	Horseback	Mixer/loader	No ARI<1	No ARI<1	No ARI<1	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone
Ground	Human	Horseback	Applicator/ mixer/loader	Diquat	Diquat	Diquat	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone
Ground	ATV	Spot	Applicator	No ARI<1	Diquat	Diquat	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone
Ground	ATV	Spot	Mixer/loader	No ARI<1	No ARI<1	No ARI<1	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone
Ground	ATV	Spot	Applicator/ mixer/loader	Diquat	Diquat	Diquat	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone
Ground	ATV	Boom/broadcast	Applicator	No ARI<1	No ARI<1	No ARI<1	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone[3]
Ground	ATV	Boom/broadcast	Mixer/loader	No ARI<1	No ARI<1	No ARI<1	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone[3]
Ground	ATV	Boom/broadcast	Applicator/ mixer/loader	No ARI<1	No ARI<1	No ARI<1	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone[3]
Ground	Truck mount	Spot	Applicator	Diquat	Diquat	Diquat	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone
Ground	Truck mount	Spot	Mixer/loader	No ARI<1	No ARI<1	No ARI<1	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone
Ground	Truck mount	Spot	Applicator/ mixer/loader	Diquat	Diquat	Diquat	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone
Ground	Truck mount	Boom/broadcast	Applicator	No ARI<1	No ARI<1	No ARI<1	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone[3]
Ground	Truck mount	Boom/broadcast	Mixer/loader	No ARI<1	No ARI<1	No ARI<1	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone[3]
Ground	Truck mount	Boom/broadcast	Applicator/ mixer/loader	Diquat	Diquat	Diquat	Diquat	Diquat	Diquat	Dicamba, diquat, fluridone[3]
Aquatic	Boat	Spot	Applicator	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	Dicamba, diquat, fluridone
Aquatic	Boat	Spot	Mixer/loader	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	Dicamba, diquat, fluridone
Aquatic	Boat	Spot	Applicator/ mixer/loader	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	Dicamba, diquat, fluridone
Aquatic	Boat	Boom/broadcast	Applicator	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	Dicamba, diquat, fluridone[3]
Aquatic	Boat	Boom/broadcast	Mixer/loader	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	Dicamba, diquat, fluridone[3]
Aquatic	Boat	Boom/broadcast	Applicator/ mixer/loader	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	Dicamba, diquat, fluridone[3]

[1] ARI values less than 1 indicate a level of concern.
[2] Concentrated solution and mixed solutions (maximum application rate and typical application rate).
[3] Boom/broadcast includes both granular and liquid forms of fluridone.

Under the accidental scenario, it is assumed that sulfometuron methyl is spilled directly onto an occupational receptor. Because sulfometuron methyl is provided by the manufacturer in granular form, it cannot be spilled as a concentrated liquid. Therefore, under the accidental scenario, it is assumed that sulfometuron methyl is spilled on the skin after it has been mixed at the maximum AR concentration. However, sulfometuron has not been shown to be toxic via short-term exposures via the dermal route and no NOAELs have been identified. Therefore, while spill concentrations were calculated, an accidental scenario ARI was not calculated.

These results show that sulfometuron methyl risks are not expected to exceed the USEPA's level of concern for any of the occupational receptors under the scenarios evaluated.

Public Receptors

The following public receptors were evaluated for potential exposure to herbicides under both routine (typical and maximum AR) and accidental exposure scenarios:

- Angler
- Berry picker - adult
- Berry picker - child
- Hiker/hunter
- Native American - adult
- Native American - child
- Nearby resident - adult
- Nearby resident - child
- Swimmer - adult
- Swimmer - child

The assumption under the routine-use scenarios is that public receptors are potentially exposed to media impacted by spray drift, while the assumption under the accidental scenarios is that receptors are potentially exposed to media directly sprayed by herbicide applications. While it is possible that public receptors use public lands under intermediate- and long-term time frames, it is unlikely that public receptors would be exposed to herbicides under the routine use scenario for more than a short-term exposure, which is defined as 1 day to 1 month (USEPA 2001g). Therefore, short-term exposures are evaluated below. An evaluation of the public receptors under an intermediate- and a long-term exposure scenario is included in the Uncertainty Analysis. Therefore, public receptors may be impacted by spray drift under routine use scenarios for the following applications:

- Aerial – plane
- Aerial – helicopter
- Boom/broadcast (truck or ATV), both low and high boom scenarios were evaluated

Because spot applications are small and focused, and very little if any spray drift is generated, public receptors are not assumed to be impacted by herbicide spray through routine use from the following applications:

- Backpack
- Horseback
- ATV - spot
- Truck - spot

Public receptors may be impacted by direct spray under the accidental scenarios for all the application methods. However, the evaluation of the spot scenarios may result in an overestimate of exposure as the spot application method is very focused, and may not encompass an area of vegetation large enough to support some of the exposure scenarios (e.g., a spot application may not encompass enough berries to support the assumed IR or may not encompass enough foliage to support the assumed dermal contact).

Dicamba

Dicamba is proposed for use on rangeland, energy and mineral sites, ROW, and recreation and cultural sites. Dicamba may be applied using the following methods: truck (boom/broadcast or spot applications), ATV (boom/broadcast or spot applications), horseback (spot applications), and backpack (spot applications). All public receptors are assumed to be potentially exposed to dicamba spray drift resulting from boom/broadcast (both low-boom and high-boom) application methods from trucks or ATVs. As noted above, spot applications are small and focused, and very little, if any, spray drift is generated; therefore, public receptors are not assumed to be impacted by herbicide a.i. spray from spot applications.

Under the routine use scenario, it is assumed that public receptors are exposed to spray drift via dermal contact, incidental ingestion, and dietary exposure pathways under both typical and maximum AR scenarios. The ARIs combine all the exposure estimates to derive a cumulative effect ARI. Routine use scenario ARIs are greater than 1 under both the typical and maximum AR scenarios for all public receptors, indicating no level of concern (Table B-12).

Under the accidental scenario, it is assumed that public receptors are exposed directly to maximum herbicide a.i. ARs (as shown in Table B-4) via dermal contact (direct spray of receptor, contact with directly sprayed vegetation, and contact with directly sprayed water), incidental ingestion of water while swimming, or dietary exposure pathways (drinking water, berry ingestion, and fish ingestion). The same maximum AR applies to all dicamba treatment application methods, as shown in Table B-4. The accidental scenario for a pond assumes that receptors swim in or obtain drinking water from a pond that has been directly sprayed with herbicide a.i. or that has received a spill from a truck. Cumulative accidental ARIs were not calculated, as it is assumed that each receptor would be accidentally exposed via one potential exposure pathway. All accidental scenario ARIs are greater than 1, indicating no level of concern (Table B-13).

These results indicate that dicamba risks are not expected to exceed the USEPA's level of concern for public receptors under the scenarios evaluated.

Diflufenzopyr

Diflufenzopyr is proposed for use on energy and mineral sites, ROW, and recreation and cultural sites. Diflufenzopyr may be applied using the following vehicles and methods: truck (boom/broadcast or spot applications), ATV (boom/broadcast or spot applications), and backpack (spot applications). All public receptors are assumed to be potentially exposed to diflufenzopyr spray drift resulting from boom/broadcast (both low-boom and high-boom) application methods from trucks or ATVs. As noted above, spot applications are small and focused, and very little if any spray drift is generated; therefore, public receptors are not assumed to be impacted by herbicide spray from spot applications.

Under the routine use scenario, it is assumed that public receptors are exposed to spray drift via dermal contact, incidental ingestion, and dietary exposure pathways under both typical and maximum AR scenarios (ARs are shown in Table B-5). The ARIs combine all the exposure estimates to derive a cumulative effect ARI. Because laboratory studies have demonstrated that diflufenzopyr is not toxic by the dermal exposure route, dermal NOAELs were not identified, and the dermal pathway is not evaluated for diflufenzopyr in this HHRA. Routine use scenario ARIs are greater than 1 under both the typical and maximum AR scenarios for all public receptors, indicating no level of concern.

Under the accidental scenario, it is assumed that public receptors are exposed directly to maximum herbicide ARs (as shown in Table B-5) via dermal contact (direct spray of receptor, contact with directly sprayed vegetation, and contact with directly sprayed water), incidental ingestion of water while swimming, or dietary exposure pathways (drinking water, berry ingestion, and fish ingestion). The same maximum AR applies to all diflufenzopyr treatment application methods, as shown in Table B-5. The accidental scenario for a pond assumes that receptors swim in or obtain drinking water from a pond that has been directly sprayed with herbicide or that has received a spill from a truck. Cumulative accidental ARIs were not calculated, as it is assumed that each receptor would be accidentally exposed via one potential exposure pathway. The ARIs for dermal contact pathways were not calculated because diflufenzopyr has not been shown to be toxic via the dermal exposure pathway. All accidental scenario ARIs are greater than 1, indicating no level of concern.

Diquat

Diquat is proposed for use on aquatic sites. Diquat may be applied using the following methods: airplane, helicopter, truck (boom/broadcast or spot applications), ATV (boom/broadcast or spot applications), boat (boom/broadcast or spot applications), horseback (spot applications), and backpack (spot applications). All public receptors are assumed to be potentially exposed to diquat spray drift resulting from aerial applications from airplanes or helicopters and boom/broadcast (both low-boom and high-boom) application methods from trucks, ATVs, or boats. As noted above, spot applications are small and focused, and very little if any spray drift is generated; therefore, public receptors are not assumed to be impacted by herbicide spray from spot applications.

- Under the routine use scenario, it is assumed that public receptors are exposed to spray drift via dermal contact, incidental ingestion, and dietary exposure pathways under both typical

and maximum AR scenarios (ARs shown in Table B-6). The ARIs combine all the exposure estimates to derive a cumulative effect ARI. The ARIs are below 1 for the following scenarios under the typical AR scenario, indicating a level of concern:

- Residential (child) – airplane and helicopter applications

Aggregate Risk Indices for diquat are below 1 for the following scenarios under the maximum AR scenario, indicating a level of concern:

- Hiker/hunter (adult) – airplane and helicopter applications
- Berry picker (child) – airplane and helicopter applications, high-boom applications
- Berry picker (adult) – airplane and helicopter applications
- Angler (adult) – airplane and helicopter applications
- Residential (child) – airplane and helicopter applications, low-boom applications, high-boom applications
- Residential (adult) – airplane and helicopter applications, low-boom applications, high-boom applications
- Native American (child) – airplane and helicopter applications, high-boom applications
- Native American (adult) – airplane and helicopter applications

Under the accidental scenario, it is assumed that public receptors are exposed directly to maximum herbicide ARs (as shown in Table B-6) via dermal contact (direct spray of receptor, contact with directly sprayed vegetation, and contact with directly sprayed water), incidental ingestion of water while swimming, or dietary exposure pathways (drinking water, berry ingestion, and fish ingestion). The same maximum AR applies to all diquat treatment application methods, as shown in Table B-6. The accidental scenario for a pond assumes that receptors swim in, or obtain drinking water from, a pond that has been directly sprayed with herbicide or that has received a spill (from a truck or helicopter). Cumulative accidental ARIs were not calculated, as it is assumed that each receptor would be accidentally exposed via one potential exposure pathway. The ARIs for diquat are less than 1 for the following receptors and pathways, indicating a level of concern.

- Angler (adult) – direct spray, contact with directly sprayed foliage, and drinking water from a pond receiving a helicopter spill
- Berry picker (adult) – direct spray, contact with directly sprayed foliage, and drinking water from a pond receiving a helicopter spill
- Berry picker (child) – direct spray, contact with directly sprayed foliage, and drinking water from a pond receiving a truck or helicopter spill
- Hiker/hunter (adult) – direct spray, contact with directly sprayed foliage, and drinking water from a pond receiving a helicopter spill
- Native American (adult) – direct spray and contact with directly sprayed foliage
- Native American (child) – direct spray, contact with directly sprayed foliage, and drinking water from a pond receiving a helicopter spill
- Nearby resident (adult) – direct spray and contact with directly sprayed foliage
- Nearby resident (child) – direct spray and contact with directly sprayed foliage
- Swimmer (adult) – swimming in a pond receiving a truck or helicopter spill
- Swimmer (child) – swimming in a pond receiving a truck or helicopter spill

A second set of calculations was performed for the scenarios listed above with ARIs below 1 under the maximum AR assuming that herbicide is sprayed or spilled at the typical rather than the maximum AR (see Table B-6). Aggregate Risk Indices for diquat for the following receptors and scenarios are below 1, indicating a level of concern:

- Angler (adult) – direct spray
- Berry picker (adult) – direct spray
- Berry picker (child) – direct spray and drinking water from a pond receiving a helicopter spill
- Hiker/hunter (adult) – direct spray
- Native American (adult) – direct spray
- Native American (child) – direct spray

TABLE B-12
Routine Public Scenarios/Receptors with Aggregate Risk Indices Below One[1]

	Routine Exposure Scenarios							
	Typical Application Rate Scenario ARIs				Maximum Application Rate Scenario ARIs			
AgDrift® Scenario:	**Aerial**	**Aerial**	**Ground**	**Ground**	**Aerial**	**Aerial**	**Ground**	**Ground**
Land Type[2]	**Agricultural**	**Agricultural**	**Agricultural**	**Agricultural**	**Agricultural**	**Agricultural**	**Agricultural**	**Agricultural**
Equipment[3]	**Plane**	**Helicopter**	**Low Boom**	**High Boom**	**Plane**	**Helicopter**	**Low Boom**	**High Boom**
Hiker/hunter (adult)	No ARI<1	No ARI<1	No ARI<1	No ARI<1	Diquat	Diquat	No ARI<1	No ARI<1
Berry picker (child)	No ARI<1	No ARI<1	No ARI<1	No ARI<1	Diquat	Diquat	No ARI<1	Diquat
Berry picker (adult)	No ARI<1	No ARI<1	No ARI<1	No ARI<1	Diquat	Diquat	No ARI<1	Diquat
Angler (adult)	No ARI<1	No ARI<1	No ARI<1	No ARI<1	Diquat	Diquat	No ARI<1	No ARI<1
Residential (child)	Diquat	Diquat	No ARI<1	No ARI<1	Diquat	Diquat	Diquat	Diquat
Residential (adult)	No ARI<1	No ARI<1	No ARI<1	No ARI<1	Diquat	Diquat	Diquat	Diquat
Native American (child)	No ARI<1	No ARI<1	No ARI<1	No ARI<1	Diquat	Diquat	No ARI<1	Diquat
Native American (adult)	No ARI<1	No ARI<1	No ARI<1	No ARI<1	Diquat	Diquat	No ARI<1	No ARI<1
Swimmer (adult)	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1
Swimmer (child)	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1	No ARI<1

[1] ARI values less than one indicate a level of concern. Only short-term exposures were considered.
[2] Agricultural land type is used as a proxy for a pond for aerial scenarios. Ground scenarios are not differentiated in AgDRIFT® by land type.
[3] Low and High Boom applies to a truck mount or a boat mount boom.

TABLE B-13
Accidental Public Scenarios with Aggregate Risk Indices Below One[1]

Receptor	Accidental Exposure Scenarios					
	Direct Spray of Receptor	Dermal Contact with Foliage	Swimming		Drinking Water Ingestion	
			Helicopter Spill	Truck Spill	Helicopter Spill	Truck Spill
Hiker/hunter (adult)	Diquat (M,T)[1]	Diquat (M)	NE	NE	Diquat (M)	No ARI<1
Berry picker (child)	Diquat (M,T) fluridone (M)	Diquat (M)	NE	NE	Diquat (M,T)	Diquat (M)
Berry picker (adult)	Diquat (M,T)	Diquat (M)	NE	NE	Diquat (M)	No ARI<1
Angler (adult)	Diquat (M,T)	Diquat (M)	NE	NE	Diquat (M)	No ARI<1
Residential (child)	Diquat (M,T) fluridone (M)	Diquat (M,T) fluridone (M,T)	NE	NE	NA	No ARI<1
Residential (adult)	Diquat (M,T)	Diquat (M,T) fluridone (M)	NE	NE	NA	No ARI<1
Native American (child)	Diquat (M,T) fluridone (M)	Diquat (M)	NE	NE	Diquat (M)	No ARI<1
Native American (adult)	Diquat (M,T)	Diquat (M)	NE	NE	No ARI<1	No ARI<1
Swimmer (child)	NE	NE	Diquat (M,T)	Diquat (M,T)	NE	NE
Swimmer (adult)	NE	NE	Diquat (M)	Diquat (M)	NE	NE

[1] ARI values less than one indicate a level of concern. These results indicate that diflufenzopyr risks are not expected to exceed the USEPA's level of concern for public receptors under the scenarios evaluated.
[2] M = Maximum application rate scenario; T = Typical application rate scenario; and NE = Not evaluated; and NA = Receptor not exposed via this pathway.

- Nearby Resident (adult) – direct spray and contact with directly sprayed foliage
- Swimmer (child) – swimming in a pond receiving a truck or helicopter spill

These results show that diquat risks could exceed the USEPA's level of concern for public receptors under certain scenarios. No risks were indicated for low-boom or high-boom application methods under typical ARs for short-, intermediate-, or long-term exposure scenarios for diquat.

Fluridone

Fluridone is proposed for use on aquatic sites. Fluridone may be applied using the following methods: airplane, helicopter, truck (boom/broadcast or spot applications), ATV (boom/broadcast or spot applications), boat (boom/broadcast or spot applications), horseback (spot applications), and backpack (spot applications). All public receptors are assumed to be potentially exposed to fluridone spray drift resulting from aerial applications from airplanes or helicopters and boom/broadcast (both low-boom and high-boom) application methods from trucks, ATVs, or boats. As noted above, spot applications are small and focused, and very little if any spray drift is generated; public receptors are not assumed to be impacted by herbicide spray from spot applications.

Under the routine use scenario, it is assumed that public receptors are exposed to spray drift via dermal contact, incidental ingestion, and dietary exposure pathways under both typical and maximum AR scenarios (shown in Table B-7). The ARIs combine all the exposure estimates to derive a cumulative effect ARI. Toxicity values are not available for acute dietary exposure for fluridone. Therefore, short-term ARIs are based on dermal and incidental oral exposure.

Routine use scenario ARIs are greater than 1 under the typical and maximum AR scenarios for all public receptors, indicating no exceedance of the USEPA's level of concern.

Under the accidental scenario, it is assumed that public receptors are exposed directly to maximum herbicide ARs (shown in Table B-7) via dermal contact (direct spray of receptor, contact with directly sprayed vegetation, and contact with directly sprayed water), incidental ingestion of water while swimming, or dietary exposure pathways (drinking water, berry ingestion, and fish ingestion). The accidental scenario for a pond assumes that receptors swim in or obtain drinking water from a pond that has been directly sprayed with herbicide or that has received a spill (from a truck or helicopter). Cumulative accidental ARIs were not calculated, as it is assumed that each receptor would be accidentally exposed via one potential exposure pathway. Accidental scenario ARIs were calculated for dermal exposure and incidental oral pathways only, because acute dietary toxicity values are not available. Aggregate Risk Indices for fluridone are less than 1 for the following receptors and pathways, indicating a level of concern:

- Berry picker (child) – direct spray
- Native American (child) – direct spray
- Residential (child) – direct spray and contact with directly sprayed foliage

A second set of calculations was performed for the scenarios listed above with ARIs below 1 under the maximum AR assuming that herbicide is sprayed or spilled at the typical AR rather than the maximum AR (see Table B-7). The ARI are equal to or above 1, indicating no exceedance of USEPA's level of concern.

These results show that fluridone risks do not exceed the USEPA's level of concern under the routine-use typical AR scenario, but could exceed the USEPA's level of concern for the nearby resident (adult and child) under the routine-use maximum AR scenario and the nearby resident (adult and child), the berry picker (child), and the Native American (child) under the accidental scenarios.

Imazapic

Imazapic is proposed for use on rangeland, public-domain forest land, energy and mineral sites, ROW, and recreational and cultural sites. Imazapic may be applied using the following methods: airplane, helicopter, truck (boom/broadcast or spot applications), ATV (boom/broadcast or spot applications), horseback (spot applications), and backpack (spot applications). All public receptors are assumed to be potentially exposed to imazapic spray drift resulting from aerial applications from airplanes or helicopters and boom/broadcast (both low-boom and high-boom) application methods from trucks or ATVs. As noted above, spot applications are small and focused, and very little if any spray drift is generated; therefore, public receptors are not assumed to be impacted by herbicide spray from spot applications.

Under the routine use scenario, it is assumed that public receptors are exposed to spray drift via dermal contact, incidental ingestion, and dietary exposure pathways under both typical and maximum AR scenarios (ARs are shown in Table B-8). The ARIs combine all the exposure estimates to derive a cumulative effect ARI. Toxicity values are not available for acute dietary exposure, short-term dermal exposure, and intermediate-term dermal exposure. Therefore, short-term ARIs are based on incidental oral exposure (and therefore are calculated only for swimming pathways). Routine use scenario ARIs for imazapic are greater than 1 under both the typical and maximum AR scenarios for all public receptors, indicating no exceedance of the USEPA's level of concern under the scenarios evaluated.

Under the accidental scenario, it is assumed that public receptors are exposed directly to maximum herbicide ARs (as shown on Table B-8) via dermal contact (direct spray of receptor, contact with directly sprayed vegetation, and contact with directly sprayed water), incidental ingestion of water while swimming, or dietary exposure pathways (drinking water, berry ingestion, and fish ingestion). The accidental scenario for a pond assumes that receptors swim in or obtain drinking water from a pond that has been directly sprayed with herbicide or that has received a spill (from a truck or helicopter). Cumulative accidental ARIs were not calculated, as it is assumed that each receptor would be accidentally exposed via only one potential exposure pathway. Accidental scenario ARIs for imazapic were calculated for incidental oral pathways only, because acute dietary and short-term dermal toxicity values are not available. Therefore, ARIs were calculated only for the swimming pathways. The ARIs for the swimming pathways are greater than one, indicating exceedance of the USEPA's level of concern under the scenarios evaluated.

These results show that imazapic risks are not expected to exceed the USEPA's level of concern for any of the public receptors under the scenarios evaluated.

Sulfometuron Methyl

Sulfometuron methyl is proposed for use on public-domain forest land, energy and mineral sites, ROW, and recreational and cultural sites. Sulfometuron methyl may be applied using the following vehicles and methods: helicopter, truck (boom/broadcast or spot applications), ATV (boom/broadcast or spot applications), horseback (spot applications), and backpack (spot applications). All public receptors are assumed to be potentially exposed to sulfometuron methyl spray drift resulting from aerial applications from helicopters and boom/broadcast (both low-boom and high-boom) application methods from trucks or ATVs. As noted above, spot applications are small and focused, and very little if any spray drift is generated; therefore, public receptors are not assumed to be impacted by herbicide spray from spot applications.

Under the routine use scenario, it is assumed that public receptors are exposed to spray drift via dermal contact, incidental ingestion, and dietary exposure pathways under both typical and maximum AR scenarios (ARs are shown in Table B-9). The ARIs combine all the exposure estimates to derive a cumulative effect ARI. Toxicity values are not available for acute dietary exposure or dermal exposure. Therefore, short-term ARIs are based on incidental oral exposure (and therefore are calculated only for swimming pathways). Routine use scenario ARIs for sulfometuron methyl are greater than 1 under both the typical and maximum AR scenarios for all public receptors, indicating no exceedance of the USEPA's level of concern under the scenarios evaluated.

Under the accidental scenario, it is assumed that public receptors are exposed directly to maximum herbicide ARs via dermal contact (direct spray of receptor, contact with directly sprayed vegetation, and contact with directly sprayed water), incidental ingestion of water while swimming, or dietary exposure pathways (drinking water, berry ingestion, and fish ingestion). The accidental scenario for a pond assumes that receptors swim in or obtain drinking water from a pond that has been directly sprayed with herbicide or that has received a spill (from a truck or helicopter). Cumulative accidental ARIs were not calculated, as it is assumed that each receptor would be accidentally exposed via only one potential exposure pathway. Accidental scenario ARIs were calculated for incidental oral pathways only because acute dietary and short-term dermal toxicity values are not available. Therefore, ARIs were calculated only for the swimming pathways. The ARIs for the swimming pathways are greater than one, indicating no exceedance of the USEPA's level of concern under the scenarios evaluated.

These results show that sulfometuron methyl risks are not expected to exceed the USEPA's level of concern for any of the public receptors under the scenarios evaluated.

Evaluation of Currently-available Herbicide Active Ingredients

This section evaluates the toxicity values used for various herbicide active ingredients that are currently available for use by the BLM and have been evaluated in previous reports, namely the *Final Environmental Impact Statement, Vegetation Treatment on BLM Lands in Thirteen Western States* (1991 13-State EIS; USDI BLM 1991) and the *Final Environmental Impact Statement, California Vegetation Management* (1988 California EIS; USDI BLM 1988). This section also compares the receptors and exposure pathways used in these HHRAs with those used in this HHRA. The purpose of this comparison is to determine whether the earlier BLM HHRAs are appropriate for current use.

Evaluation of Dose-response Values Used in Previous EISs

This section compares the dose-response values used for herbicide active ingredients that are in current use and were evaluated in previous EISs with values developed under current USEPA OPP policy. Most of the herbicide active ingredients were evaluated in the 1991 13-State EIS HHRA. Three of the herbicides (asulam, 2,4-DP, and fosamine) were evaluated in the 1988 California EIS HHRA. The 1988 California EIS and 1991 13-State EIS HHRAs used two NOAELs for each herbicide active ingredient—a systemic NOAEL and a reproductive/teratogenic NOAEL. In contrast, the current approach from the USEPA OPP uses a variety of NOAELs based on exposure duration rather than specific health outcome, as well as acute and chronic dietary PADs. The PAD is the NOAEL divided by an uncertainty factor, typically 100. Therefore, multiplying the PAD by 100 allows one to compare the value to a NOAEL. The NOAELs used in the current risk assessment are based on the most sensitive effect (i.e., they were not identified separately by endpoints, such as systemic effects or reproductive/teratogenic effects); therefore, they are conservative values. Lower NOAELs indicate higher potential toxicity. The Cancer Slope Factors (CSF) used in the 1988 California EIS and the 1991 13-State EIS were also compared with any recent CSFs for those active ingredients. Higher CSFs indicate higher potential toxicity.

The dose-response values used the earlier HHRAs for most of the herbicide active ingredients are conservative in comparison to current toxicity values, with the following exceptions:

Asulam

The short-term and intermediate-term NOAEL for all exposure routes is 50 mg/kg-day, which is the same value as the systemic and reproductive NOAELs used in the 1988 California EIS HHRA. The long-term NOAEL for all exposure routes is 36 mg/kg-day, which is slightly lower than the NOAEL of 50 mg/kg-day used in the 1988 California EIS HHRA. The 1988 California EIS HHRA showed that routine exposures to the public and workers do not result in unacceptable risks. The slightly lower long-term NOAEL would not significantly change this outcome. Asulam has not been used by the BLM since at least 1997.

Diuron

The chronic dietary PAD of 0.003 mg/kg-day is based on a LOAEL of 1 mg/kg-day. Assuming that there is an extra UF of 3 because of the use of a LOAEL rather than a NOAEL, the corresponding NOAEL would be 0.3 mg/kg-day. This value is slightly lower than the systemic NOAEL of 0.625 mg/kg-day used in the 1991 13-State EIS HHRA, indicating that the estimated noncancer risk for diuron could be higher using the new toxicity value. In addition, the USEPA has developed a cancer slope factor for diuron of 1.91×10^{-2}/mg/kg-day, whereas the 1991 13-State EIS HHRA did not evaluate diuron for its potentially carcinogenic effects. Information provided by BLM states that the 4-year average (2000 to 2003) of acres treated by diuron is 964; therefore, this active ingredient has been used recently though not extensively. These results indicate that a current risk assessment of diuron would evaluate potentially carcinogenic effects. The 1991 13-State EIS HHRA showed potential unacceptable risks for this herbicide active ingredient, and this conclusion would remain if the more recent toxicity values were used.

Fosamine

The chronic dietary PAD of 0.01 mg/kg-day is based on a NOAEL of 10 mg/kg-day. This value is lower than the systemic NOAEL of 25 mg/kg-day used in the 1988 California EIS HHRA, indicating that the estimated noncancer risk for fosamine could be higher using the new toxicity value. The 1988 California EIS HHRA showed that routine exposures to the public and workers do not result in unacceptable risks for this herbicide active ingredient. Because the difference between the two NOAELs is relatively small, this outcome would likely not change with use of the newer toxicity value.

Fosamine has been used sparingly in recent years by the BLM(< 50 acres annually).

Simazine

The chronic dietary PAD of 0.005 mg/kg-day is based on a NOAEL of 0.5 mg/kg-day, which is lower than the NOAEL of 5 mg/kg-day used in the 1991 13-State EIS HHRA, indicating that the estimated noncancer risk for simazine could be higher using the new toxicity value. However, information provided by BLM states that simazine has not been used since 1997; therefore, there is no exposure to this herbicide active ingredient, and the toxicity value change would not significantly affect its use.

Triclopyr

The chronic dietary PAD of 0.005 mg/kg-day is based on a NOAEL of 0.5 mg/kg-day, which is lower than the NOAEL of 2.5 mg/kg-day used in the 1991 13-State EIS HHRA, indicating that the estimated noncancer risk for triclopyr could be 5-fold higher using the new toxicity value. Information provided by BLM states that the 4-year average (2000 to 2003) of acres treated by triclopyr is 4,737; therefore, this active ingredient has been used recently. The 1991 13-State EIS HHRA showed potential unacceptable risks for this herbicide active ingredient, and this conclusion would remain if the more recent toxicity values were used.

In summary, diuron, simazine, and triclopyr are the only herbicide active ingredients for which there are more stringent current dose-response values than those used in the 1991 13-State EIS HHRA. Simazine has not been used in the 4-year period of 50 mg/kg-day therefore, there is no exposure to this herbicide active ingredient, and the toxicity value change does not affect potential risks. Both diuron and triclopyr were found to pose potentially unacceptable risks in the 1991 13-State EIS HHRA; therefore, this conclusion would remain if the more stringent current toxicity values were used.

Evaluation of Receptors and Exposure Pathways Used in the Earlier Human Health Risk Assessments

The 1988 California EIS and 1991 13-State EIS HHRAs and the current HHRA evaluate occupational and public receptors. The risk assessments evaluated the same occupational scenarios—that of a worker potentially exposed to herbicide active ingredients via dermal contact and inhalation during routine applications and of a worker potentially exposed to an accidental spill of herbicide active ingredient to his or her skin.

The public receptors in both risk assessments are similar. The exposure scenarios are also similar, with two exceptions: the 1991 13-State EIS HHRA did not evaluate a swimming scenario, and the current HHRA does not evaluate a Native American game ingestion scenario (in accordance with discussions with the USEPA). Therefore, the current risk assessment evaluates a more conservative pond pathway and a slightly less conservative Native American pathway. Other than these minor differences, the exposure pathways for both risk assessments are similar.

Summary of Currently-available Herbicide Active Ingredient Evaluation

Based on the general similarity of the risk assessments conducted by the BLM in 1988 and 1991 and the current risk assessment, it is likely that the risk estimates calculated previously would not differ significantly from risk estimates calculated for the present herbicide active ingredients using the updated risk assessment methods and the updated toxicity values. Therefore, new risk assessments were not conducted for the herbicides currently in use other than sulfometuron methyl and dicamba. These herbicide active ingredients were evaluated in the current HHRA because of alternative exposure pathways and concomitant exposures with other herbicide active ingredients.

Uncertainty Analysis

Uncertainty is introduced into the risk assessment in several places throughout the process. Every time an assumption is made, some level of uncertainty is introduced into the risk assessment. In accordance with USEPA guidance (USEPA 1989), the uncertainty associated with each step of the risk characterization process is discussed in this section of the report.

Within any of the four steps of the human health risk evaluation process, assumptions must be made due to a lack of absolute scientific knowledge. Some of the assumptions are supported by considerable scientific evidence, while others have less support. Every assumption introduces some degree of uncertainty into the risk evaluation process. Regulatory risk evaluation methodology requires that conservative assumptions be made throughout the risk evaluation to ensure that public health is protected. Therefore, when all of the

assumptions are combined, it is much more likely that risks are overestimated rather than underestimated.

Hazard Identification

The Hazard Identification step involves identifying the herbicides to be evaluated quantitatively in the HHRA and providing toxicity information. The six herbicides evaluated in this HHRA were identified by the BLM, and represent herbicides proposed for use by the BLM that have not been evaluated in previous EISs (with the exception of sulfometuron methyl, which was previously evaluated). Toxicity information on these herbicides was collected mainly from USEPA reports that have compiled results of toxicity studies conducted by the manufacturers and other entities. For the most part, the USEPA had sufficient information to place the herbicides in the appropriate acute toxicity categories, and to determine their carcinogenic potential. Appropriate studies were available on subchronic, chronic, developmental, and reproductive toxicity. While there is always uncertainty in extrapolating animal information to humans, sufficient information was available to make a determination on toxicity for these herbicides.

Dose-response Assessment

The purpose of the dose-response assessment is to define the relationship between the dose of a chemical and the likelihood or magnitude of an adverse effect (response). Risk assessment methodologies typically divide potential health effects of concern into two general categories: effects with a threshold (noncarcinogenic) and effects assumed to be without a threshold (potentially carcinogenic). None of the six herbicides evaluated in this HHRA are designated as potential carcinogens by the USEPA; therefore, noncancer dose-response values were used in the evaluation. There are several sources of uncertainty in the development of dose-response values.

Animal-to-human Extrapolation

For many chemicals, animal studies provide the only reliable information on which to base an estimate of adverse human health effects. Extrapolation from animals to humans introduces uncertainty into the risk characterization. Usually, the difference between the human reaction to a chemical and the test animal reaction to a chemical is unknown. If a chemical's fate and the mechanisms by which it causes adverse effects are known in both animals and humans, uncertainty is reduced. When the fate and mechanism for the chemical are unknown, uncertainty increases.

Conservative assumptions that incorporate UFs are used to extrapolate from animals to humans such that it is more likely that effects in humans are overestimated than underestimated. When data are available from several species, the highest dose that that does not cause effects in the most sensitive species is used to determine the NOAEL, which is used to calculate the RfD and the PAD. The PAD is calculated by dividing the NOAEL by UFs, generally of 1 to 10 each, to account for intraspecies variability, interspecies variability, and study duration. When using the NOAEL to calculate MOEs, the target MOE is typically 100 to account for intraspecies and interspecies variability. Generally, additional UFs for study duration are not required, because separate NOAELs are used for short-, intermediate-, and long-term exposures.

The use of the UFs compensates for uncertainties involved in extrapolating from animals to humans. Nevertheless, because the fate of a chemical can differ in animals and humans, it is possible that animal experiments will not reveal an adverse effect that would manifest itself in humans. This can result in an underestimation of the effects in humans. The opposite may also be true: effects observed in animals may not be observed in humans, resulting in an overestimation of potential adverse human health effects.

Availability of NOAELs

NOAELs for all of the exposure durations and routes are not available for all of the herbicides. In most cases, the USEPA did not develop specific NOAELs because the herbicide is not considered toxic through a specific exposure route. For example, there are no dermal NOAELs for diflufenzopyr because a dermal toxicity study did not show any effects at the limit dose of 1,000 mg/kg-day (USEPA 2002b). Therefore, risk calculations were not conducted for certain herbicides and certain exposure routes. It is likely that risks are not being underestimated because the specific exposure route is unlikely to show toxicity.

Exposure Assessment

There are uncertainties involved in the development of exposure scenarios and in the estimation of herbicide doses to which humans could be exposed.

Exposure Scenarios

Exposure scenarios in a risk evaluation are selected to be representative of current and reasonably foreseeable site use. In accordance with pesticide risk assessment approaches, both occupational and public (non-worker) receptors were evaluated. The selection of occupational receptors considered the BLM's specific land programs, application types, application vehicles, and application methods. The occupational receptors include pilots, applicators, mixer/loaders, and combined applicator/mixer/loaders. Most occupational receptors are likely to have little herbicide exposure because of the use of PPE and other health and safety precautions. The accidental spill scenario evaluated for the occupational receptor is also very unlikely since a worker would take necessary precautions to prevent spills.

The HHRA evaluated a wide range of potential public receptors, including hiker/hunters, berry pickers, anglers, swimmers, nearby residents, and Native Americans. Although there are many different exposure scenarios and receptors that could be evaluated, these receptors cover a range of potential exposures that could occur under worst case conditions on BLM lands. It is assumed that these receptors could be exposed through a number of exposure pathways, such as herbicide spray, contact with sprayed foliage, contact with sprayed water through drinking or swimming, and ingestion of sprayed berries and fish that have bioaccumulated herbicide from sprayed water. Under the routine scenarios, receptors are assumed to be exposed to spray drift, while under the accidental scenarios, receptors are assumed to be exposed to direct spray. The Native American receptor is assumed to be exposed through all of these exposure pathways, which is likely to be a conservative assumption.

While it is possible that public receptors use public lands under intermediate- and long term-time frames, it is unlikely that public receptors would be exposed to herbicides under the routine use scenario for more than a short-term exposure, which is defined as 1 day to 1 month (USEPA 2001g). Therefore, a short-term scenario was evaluated in this HHRA. Although it is highly unlikely that public receptors would be potentially exposed to herbicides for longer than a short-term time frame, both an intermediate- and a long-term exposure scenario are also evaluated in this HHRA.

Estimation of Dose

Various conservative assumptions were made to estimate the herbicide doses to which occupational and public receptors could be exposed. For the occupational receptors, exposure doses were estimated using UE information from the PHED, which is a generic database containing dermal and inhalation exposure data for workers mixing, loading, or applying pesticides. The USEPA has developed a series of standard UE values for various exposure scenarios, which were used in this HHRA. For the occupational worker accidental spill scenario, it was assumed that the herbicide could spill directly onto the worker and be absorbed through the skin. These exposure pathways are likely to result in conservative risk estimates.

For the public receptors, various conservative assumptions were used to estimate exposures. These exposure assumptions were generally derived from USEPA databases, such as the *Exposure Factors Handbook* (USEPA 1997a). The exposure assumptions listed in these guidance documents are generally conservative, and are meant to account for a wide range of exposure situations. To estimate exposures to the public from off-site deposition of herbicides, the computer model, AgDRIFT® (SDTF 2002), was used. The AgDRIFT® Tier I and Tier II evaluations were used in this HHRA because they allow the development of routine generic application scenarios that are more representative of the range of applications likely employed by the BLM. The terrestrial DRs and water concentrations calculated by AgDRIFT® are likely to be upper-end estimates. The computer model GLEAMS was used to estimate runoff of the terrestrial herbicides into ponds. For the three terrestrial herbicides, pond concentrations calculated in AgDRIFT® were added to the highest pond concentrations calculated in GLEAMS. This likely overestimates the true pond concentrations because AgDRIFT® concentrations represent relatively short duration concentrations. It is unlikely that a receptor would be exposed to pond water on the day that both drift concentrations and runoff concentrations are present.

Worst-case assumptions were made to evaluate the accidental spray and spill scenarios. The accidental spray scenario assumed that the receptor was exposed to direct spray at the maximum herbicide AR. The spill scenario assumed that a fully-loaded truck or helicopter emptied its contents into a pond while transporting the herbicide to the application site. In reality, the BLM requires that the herbicide be mixed at the application site; therefore, it is unlikely that premixed herbicide

would be transported from one location to another. This scenario represents a worst-case scenario that is unlikely to occur.

Risk Characterization

The potential risk of adverse human health effects is characterized based on estimated potential exposures and potential dose-response relationships. Generally, the goal of a risk evaluation is to estimate a reasonable upper-bound to potential exposure and risk. Most of the assumptions about exposure and toxicity used in this evaluation are representative of statistical upper-bounds or even maxima for each parameter. The result of combining several such upper-bound assumptions is that the final estimate of potential exposure or potential risk is extremely conservative.

The health risks estimated in the risk characterization generally apply to the receptors whose activities and locations were described in the exposure assessment. Some people will always be more sensitive than the average person and, therefore, will be at greater risk. Dose-response values used to calculate risk, however, are frequently derived to account for additional sensitivity of subpopulations (e.g., an UF of 10 is used to account for intraspecies differences). Therefore, it is unlikely that this source of uncertainty contributes significantly to the overall uncertainty of the risk assessment.

The large number of assumptions made in the risk characterization introduces uncertainty in the results. Any one person's potential exposure and subsequent risk are influenced by all the parameters mentioned above and will vary on a case-by-case basis. Despite inevitable uncertainties associated with the steps used to derive potential risks, the use of numerous conservative (health-protective) assumptions will most likely lead to a large overestimate of potential risks from the site.

Public Receptors – Intermediate- and Long-term Exposure Scenario

As stated previously, it is unlikely that public receptors would be potentially exposed to herbicides for more than a short-term exposure period. Although it is highly unlikely that public receptors would be potentially exposed to herbicides for longer than a short-term time frame, both an intermediate- and a long-term exposure scenario are evaluated in this uncertainty analysis. While these exposures are extremely unlikely, they were included in the uncertainty analysis for completeness.

Routine use scenario ARIs for intermediate- and long-term exposure scenarios are greater than 1 under both the typical and maximum AR scenarios for all public receptors for dicamba, diflufenzopyr, imazapic, and sulfometuron methyl, indicating no level of concern. ARIs for diquat and fluridone are below 1 for the following intermediate- and long-term scenarios under the typical AR scenario, indicating a level of concern:

Diquat. ARIs for diquat are below 1 for the following scenarios under the typical AR scenario (intermediate- and long-term), indicating a level of concern:

- Berry picker (child) – airplane and helicopter applications (intermediate- and long-term exposures)
- Residential (child) – airplane and helicopter applications (intermediate- and long-term exposures)
- Residential (adult) – airplane and helicopter applications (intermediate- and long-term exposures)
- Native American (child) – airplane and helicopter applications (intermediate- and long-term exposures)

ARIs for diquat are below 1 for the following scenarios under the maximum AR scenario (intermediate- and long-term), indicating a level of concern:

- Hiker/hunter (adult) – airplane and helicopter applications (intermediate- and long-term exposures)
- Berry picker (child) – airplane and helicopter applications (intermediate- and long-term exposures), high-boom applications (intermediate- and long-term exposures)
- Berry picker (adult) – airplane and helicopter applications (intermediate- and long-term exposures)
- Angler (adult) – airplane and helicopter applications (intermediate- and long-term exposures)
- Residential (child) – airplane and helicopter applications (intermediate- and long-term exposures), low-boom applications (intermediate- and long-term exposures), and high-boom applications (intermediate- and long-term exposures)

APPENDIX C

ECOLOGICAL RISK ASSESSMENT

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

ac	-	Acres
a.i.	-	Active ingredient
ATV	-	All terrain vehicle
BA	-	Biological Assessment
BcF	-	Bioconcentration factor
BLM	-	Bureau of Land Management
BO	-	Biological Opinion
BW	-	Body weight
CA OEHHA	-	California Office of Environmental Health Hazard Assessment
CM	-	Conceptual model
cm	-	Centimeter
cms	-	Cubic meters per second
CREAMS	-	Chemical Runoff Erosion Assessment Management System
C_{pond}	-	Concentrations from pond surface water
EC_{25}	-	Concentration causing 25% inhibition of a process (effect concentration)
EC_{50}	-	Concentration causing 50% inhibition of a process (median effective concentration)
Ed.	-	Edition
EEC	-	Estimated exposure concentration
EFED	-	Environmental Fate and Effects Division
EIS	-	Environmental Impact Statement
ERA	-	Ecological risk assessment
FCM	-	Food chain multiplier
FIFRA	-	Federal Insecticide, Fungicide, and Rodenticide Act
ft	-	Feet
g	-	Grams
gal	-	Gallon
GLEAMS	-	Groundwater Loading Effects of Agricultural Management Systems
HSDB	-	Hazardous Substances Data Bank
in	-	Inch
IRIS	-	Integrated Risk Information System
ISO	-	International Organization for Standardization
kg	-	Kilogram
km	-	Kilometers
L	-	Liters
lbs	-	Pounds
LC_{50}	-	Concentration causing 50% mortality (median lethal concentration)
LD_{50}	-	Dose causing 50% mortality (median lethal dose)
LOAEL	-	Lowest observed adverse effect level
LOC	-	Level of concern
Log	-	Common logarithm (base 10)
m	-	Meters
mg	-	Milligrams
mg/kg	-	Milligrams per kilogram
mg/L	-	Milligrams per Liter
µg	-	Micrograms
µm	-	Micrometers
mmHg	-	Millimeters of mercury
MRID	-	Master Record Identifier Number
MSDS	-	Material safety data sheet

LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS (Cont.)

NASA	-	National Aeronautics and Space Administration
NASQAN	-	National Stream Quality Accounting Network
NCDC	-	National Climatic Data Center
NOAA	-	National Oceanic and Atmospheric Administration
NOAEL	-	No observed adverse effect level
NWS	-	National Weather Service
OPP	-	Office of Pesticide Programs
PEIS	-	Programmatic Environmental Impact Statement
PM	-	Particulate matter
ROW	-	Rights-of-way
RQ	-	Risk quotient
RTE	-	Rare, threatened, and endangered
RTEC	-	Registry of Toxic Effects of Chemical Substances
SAMSON	-	Solar and Meteorological Surface Observation Network
SDTF	-	Spray Drift Task Force
TRV	-	Toxicity reference value
TSP	-	Total suspended particulates
US	-	United States
USDA	-	United States Department of Agriculture
USDI	-	United States Department of the Interior
USEPA	-	United States Environmental Protection Agency
USFWS	-	United States Fish and Wildlife Service
USGS	-	United States Geological Survey
USLE	-	Universal Soil Loss Equation
>	-	Greater than
<	-	Less than
=	-	Equal to

APPENDIX C

ECOLOGICAL RISK ASSESSMENT

The purpose of this appendix is to summarize the ecological risks to plants and animals from 10 herbicides currently used, or proposed for use, by the United States Department of the Interior Bureau of Land Management (USDI BLM). More detailed assessments of these risks are given in Ecological Risk Assessments (ERA) prepared for each herbicide (see ENSR 2005a-j). These ERAs will be used by the BLM, in conjunction with analyses of other treatment effects on plants, animals, and other resources, to determine which of the proposed treatment alternatives evaluated in the Programmatic Environmental Impact Statement (PEIS) should be employed by the BLM. The BLM field offices will also utilize these ERAs for guidance on the proper application of herbicides to ensure that impacts to plants and animals are minimized to the extent practical when treating vegetation and do not pose unacceptable risks to non-target species, including rare, threatened, and endangered (RTE) species. The U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries), in their preparation of a Biological Opinion (BO), will also use the information provided by the ERAs to assess the potential impact of vegetation treatment actions on fish and wildlife and their critical habitats.

The herbicide active ingredients (a.i.) evaluated in the ERAs are bromacil, chlorsulfuron, diflufenzopyr, diquat, diuron, fluridone, imazapic, Overdrive® (a mix of dicamba and diflufenzopyr), sulfometuron methyl, and tebuthiuron. Updated risk assessment methods were developed for the ERA process and are described in a separate document, *Vegetation Treatments Programmatic EIS Ecological Risk Assessment Methodology* (hereafter referred to as the "Methods Document" [ENSR 2004]). In addition, eight other herbicides are currently being used by the BLM and are proposed for continued use. These herbicides have been evaluated in a previous BLM EIS (USDI BLM 1991), as well as more recently in an invasive plant EIS prepared by the U.S. Department of Agriculture Forest Service (Forest Service; USDA Forest Service 2004).

Structure and Methodology of the Ecological Risk Assessment

Problem Formulation

Assessment endpoints represent "explicit expressions of the actual environmental value that is to be protected, operationally defined by an ecological entity and its attributes" (U.S. Environmental Protection Agency [USEPA] 1998). In the context of the screening-level, programmatic risk assessment, ecological entities include terrestrial invertebrates and vertebrates, non-target plants, and aquatic organisms (including RTE species). The essential biological requirements (i.e., survival, growth, and reproduction) for each of these groups of organisms are the attributes to be protected from herbicide exposure. Assessment endpoints, for the most part, reflect direct effects of an herbicide on these organisms, but indirect effects were also considered (particularly for threatened and endangered salmonids).

Measures of effect are measurable changes in an attribute of an assessment endpoint (or its surrogate, as discussed below) in response to a stressor to which it is exposed (USEPA 1998). For the screening-level ERA, the measures of effect associated with the assessment endpoints generally consisted of acute and chronic toxicity data (from pesticide registration documents and from the available scientific literature) for the most appropriate surrogate species. Rather than assess potential ecological risk to the large number of species found on public lands, surrogate species were used to represent classes of receptors (e.g., small mammalian herbivores, large avian piscivores [fish-eating birds]). In general, the surrogate species selected were those for which toxicity data were available from tests conducted in support of the USEPA pesticide registration process. Extrapolating chemical toxicity from a surrogate species to a particular species of concern can introduce extrapolation uncertainties (Fairbrother and Kapustka 1996, SERA 2000), but is often necessary in an ERA.

Assessment endpoints (and associated measures of effect) were generated in the problem formulation for each herbicide. Selection of specific assessment endpoints depends on the type of herbicide and its use pattern (e.g., terrestrial vs. aquatic application) and on the availability of appropriate toxicity data. Assessment endpoints include:

- Assessment Endpoint 1: *Acute mortality to mammals, birds, invertebrates, non-target plants.* Measures of effect included median lethal effect doses (the dose lethal to 50% of organisms tested [LD_{50}]) from acute toxicity tests with these organisms or suitable surrogates.

- Assessment Endpoint 2: *Acute mortality to fish, aquatic* invertebrates, *and aquatic plants.* Measures of effect included median lethal effect concentrations (the concentration lethal to 50% of organisms tested [LC_{50}]) from acute toxicity tests with these organisms or suitable surrogates (e.g., other coldwater fish are used to represent threatened and endangered salmonids).

- Assessment Endpoint 3: *Adverse direct effects on growth, reproduction, or other ecologically important sublethal processes.* Measures of effect included standard chronic toxicity test endpoints such as the no observed adverse effect level ([NOAEL] the dose or concentration tested at which no adverse effects on test organisms were noted) for both terrestrial and aquatic organisms. Depending on data available for a given herbicide, chronic endpoints reflect either sublethal individual impacts (e.g., survival, growth, physiological impairment, behavior), or population-level impacts (e.g., reproduction [Barnthouse 1993]). For salmonids, careful attention was paid to smoltification (i.e., development of tolerance to seawater and other changes of parr [freshwater stage salmonids] to adulthood), thermoregulation (i.e., ability to maintain body temperature), migratory behavior, and other important life processes, if such data were available. With the exception of non-target plants, standard acute and chronic toxicity test endpoints were used for estimates of direct herbicide effects on RTE species. To add conservatism to the RTE assessment, levels of concern (LOCs) for RTE animals were lower than for typical species. Lowest available germination NOAELs were used to evaluate RTE plants.

- Assessment Endpoint 4: *Adverse indirect effects on the survival, growth, or reproduction of salmonids.* Measures of Effect for this assessment endpoint depended on the availability of appropriate scientific data. Unless literature studies were found that explicitly evaluated the indirect effects of the target herbicides to salmonids and their habitat, estimates of indirect effects were qualitative. Such qualitative estimates of indirect effects include general evaluations of the potential risks to food (typically represented by acute and/or chronic toxicity to aquatic invertebrates) and cover (typically represented by potential for destruction of riparian vegetation). The USEPA Office of Pesticide Programs (OPP) is currently applying approaches similar to these qualitative evaluations for RTE species effects determinations and consultations.

Exposure Characterization

The BLM uses herbicides in a variety of programs (e.g., maintenance of rangeland and recreational sites) using several different application methods (e.g., application by aircraft, vehicle, backpack). In order to assess the potential ecological impacts of these herbicide uses, a variety of exposure scenarios were considered. These scenarios were selected based on actual BLM herbicide usage under a variety of conditions. There are differences among the individual herbicide risk assessment results based on the actual uses of a particular herbicide. Differences may include those attributable to application methodology (ground vs. aerial), area of application (forest vs. non-forest), or herbicide type (aquatic vs. terrestrial).

The exposure scenarios considered in the ERAs were organized by potential exposure pathways. In general, the exposure scenarios describe how a particular receptor group (e.g., terrestrial animals) may be exposed to the herbicide as a result of a particular exposure pathway. These exposure scenarios were designed to address herbicide exposure that may occur under a variety of conditions:

- Direct spray of the receptor or waterbody

- Indirect contact with dislodgeable foliar residue

- Ingestion of contaminated food items
- Off-site drift of spray to terrestrial areas and waterbodies
- Surface runoff from the application area to off-site soils or waterbodies
- Wind erosion resulting in deposition of contaminated dust
- Accidental spills to waterbodies

These scenarios were developed to address potential acute and chronic impacts to receptors under a variety of exposure conditions that may occur within public lands. These exposure conditions include normal application situations and associated off-site transport (via drift or wind erosion of dust), as well as accidental spills, and long-term overland flow to off-site soils and waterbodies (primarily via surface runoff and root-zone groundwater flow).

Additional details regarding specific receptors (e.g., receptor size, diet, RTE species status), application rates (e.g., typical vs. maximum applications rates, accidental spills), duration of herbicide exposure (e.g., one time event, longer term exposure), and toxicity endpoints (e.g., acute, chronic) are discussed below. Additional information can be found in the individual ERAs and associated risk assessment spreadsheets compiled for each herbicide (ENSR 2005a-j).

Because of the differences in the application methods for terrestrial and aquatic herbicides, there were fewer exposure scenarios for aquatic herbicides. Off-site transport of the aquatic herbicides via surface runoff and wind erosion were not considered to be realistic scenarios for these applications and were therefore not considered for the aquatic herbicides. However, accidental direct spray of aquatic herbicides onto terrestrial receptors and off-site drift onto terrestrial plants were considered. The more conservative direct spray scenario was assumed to address any potential impacts from the other transport mechanisms. Details of the exposure scenarios considered in the risk assessments are presented in Section 3.0 of the Methods Document (ENSR 2004).

Herbicide levels resulting in potential risk to surrogate species were calculated using conservative assumptions. Exposure scenarios were included that are unlikely to occur (e.g., direct spray of receptor or waterbody, accidental spills to waterbodies). Furthermore, animals were assumed to have a home range equal to the application area, whereas many animals would range outside of application areas, reducing exposure. In addition, all applied herbicide was assumed to be biologically available, and no attempt was made to assess the tendency of herbicide degradation or water flow to decrease herbicide concentrations and exposure (see Appendix B of the ERAs [ENSR 2005a-j] for equations and calculations for each of the different exposure scenarios).

Exposure characterizations depend on the selection of appropriate fate and transport models that predict herbicide concentrations in various environmental media, such as tissues, soils, and water. Some of these models are fairly straightforward and only require simple algebraic calculations (e.g., water concentrations from direct aerial spray), but others instead require more complex computer models (e.g., aerial deposition rates, transport from soils).

The AgDRIFT® computer model (see page C-85) was used to estimate off-site herbicide transport due to spray drift. The Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) computer model (see page C-86) was used to estimate off-site transport of herbicide in surface runoff and root-zone groundwater transport (Knisel and Davis 2000). The computer model California Puff (CALPUFF; see page C-86) was used to predict the transport and deposition of herbicides sorbed (i.e., reversibly or temporarily attached) to wind-blown dust. Each model simulation was approached with the intent of predicting the maximum potential herbicide concentration that could result from the given exposure scenario.

Effects Characterization

The ecological effects characterization phase of an ERA entails a compilation and analysis of the stressor-response relationships and any other evidence of adverse impacts from exposure to each herbicide. This evidence consisted mostly of toxicity studies conducted in support of USEPA pesticide registration, which generally include the following (additional studies may be required depending on herbicide use patterns and characteristics:

- Avian oral LD_{50}
- Avian dietary LC_{50}
- Freshwater fish acute LC_{50}

- Freshwater invertebrate acute LC_{50}

Additional tests, if required for a particular herbicide, may include honeybee acute toxicity, avian reproduction, non-target plant toxicity, and chronic fish life-cycle tests, among others. As data were not available for all receptors or for threatened/endangered species, extrapolation of risk based on surrogate species data was necessary. Species for which toxicity data were available were not necessarily the most sensitive species to a particular herbicide (these species are used as laboratory test organisms because they are generally sensitive to stressors and they can be maintained under laboratory conditions). The selected toxicity value for a receptor is based on a review of the available data for the most appropriate, sensitive surrogate species.

In the majority of cases, toxicological data do not exist for the specific ecological receptors of concern. Consequently, toxicological data for surrogate species were evaluated and used to establish quantitative benchmarks for the ecological receptors of concern. These benchmark values are referred to as toxicity reference values (TRVs). This section of text briefly describes the process used to derive TRVs. Once developed, TRVs were compared with predicted environmental concentrations of the herbicide to determine the likelihood of adverse effects to ecological receptors.

Literature Review

The literature review process for deriving TRVs consisted of assembling relevant literature, evaluating these information sources, and then establishing specific numeric values for each ecological receptor. Literature sources included published manuscripts, unpublished study reports, and electronic databases. Once data from these various sources were compiled, the information was reviewed to determine its acceptability for deriving ecological TRVs for each of the 10 herbicides. In order to be classified as an "acceptable" study, the research had to be suitable and of adequate quality (see following sections).

Data Suitability

For each chemical, the available literature was evaluated to determine if the data were suitable for use in deriving TRVs. Early in the ERA process, the BLM identified receptors that were representative of ecological guilds (i.e., general taxonomic groups comprised of animals or plants that perform particular roles in the ecosystem, including small and large mammals, small and large birds, piscivorous birds, fish, reptiles, insects, amphibians, terrestrial and aquatic plants, and algae) and their primary routes of exposure. Evaluation of suitability was based on these ecological receptors and routes of exposure. Specifically, a study was considered suitable if the following criteria were met:

- The material tested was one of the 10 herbicides;
- the test species was in the same guild as an ecological receptor;
- the route of exposure matched the primary routes of exposure for species in that guild; and
- the toxicity assessment endpoint (e.g., mortality, reproductive success, growth) was considered to be ecologically relevant.

For the majority of studies, the acute statistical measures of effect consisted of LD_{50}, LC_{50}, or EC_{50} (the concentration resulting in a defined effect in 50% of the receptors tested) values. Adverse effect levels in chronic studies were most frequently reported as lowest observed adverse effect levels (LOAELs). Levels at which no effects were noted were generally reported in chronic studies as NOAELs. Several additional statistical endpoints were evaluated for terrestrial plants, including EC_{25} (the concentration resulting in a defined effect in 25% of the receptors tested), NOAEL, and highest and lowest NOAEL (for germination and emergence endpoints only).

Data Adequacy

Once determined to be suitable, a study was then evaluated to determine whether the data were adequate. For peer-reviewed literature, two senior toxicologists independently determined data adequacy. Each paper was scored based on several selection criteria, including documentation of number of test organisms, statistical analysis, and proper use and performance of controls. Based on these reviews, the study was classified as either "adequate" or "not adequate."

Toxicity Reference Value Development

Study findings met both data adequacy and suitability criteria were used to develop ecological TRVs. From these studies, statistical endpoints were compiled into

a matrix for each chemical and for each receptor. Data were further subdivided into acute adverse effect levels, chronic adverse effect levels, and no adverse effect levels.

Endpoints for a receptor and routes of exposure were converted to the same units (e.g., mg/kg body weight [BW]). Endpoints for aquatic organisms and terrestrial plants were reported based on exposure concentrations (mg/L and lbs/acre [ac], respectively). Dose-based endpoints (e.g., LD_{50}) were used for the remaining receptors. When possible, dose-based endpoints were obtained directly from the literature. When dosages were not reported, dietary concentration data (e.g., LC_{50}) were converted to dose-based values following the methodology recommended in USEPA risk assessment guidelines (Sample et al. 1996). See the ERA Methods document (ENSR 2004; Table 2-3) for a summary of animal body weights and feeding and drinking ingestion rates that were used to convert concentration endpoints to dose-based endpoints.

Toxicity Reference Value Derivation

Once the data were expressed in comparable units, the numeric values from studies classified as "acceptable" were compared to derive TRVs. For each chemical, receptor, and route of exposure, the lowest reported acute statistical endpoint was selected as the acute TRV. Acute TRVs were derived first to provide an upper boundary for the remaining TRVs; chronic TRVs and NOAELs were always equivalent to, or less than, the acute TRV.

The toxicity endpoint for most acute studies was mortality, immobilization, or failure to germinate, as assessed during a short-term exposure. In some cases, acute data were not always available. Consequently, chronic TRVs, based on longer exposure periods and associated endpoints such as growth and reproduction, were developed to provide supplementary data to the risk assessment. Conversely, when no valid statistical endpoints from chronic studies were available, the chronic TRV was set equal to the acute TRV. In the majority of cases, however, chronic data were available. Before the chronic NOAEL TRV was determined, a chronic LOAEL was identified, which was the lowest herbicide level that was found to cause significant adverse effects in a chronic study. Once a LOAEL was established, the chronic NOAEL TRV was established as the highest NOAEL value that was less than both the LOAEL and the acute TRV.

Use of the Uncertainty Factor

In some cases, a TRV for a particular assessment endpoint had to be extrapolated from available TRVs using an uncertainty factor. Based on a review of the application of uncertainty factors (Chapman et al. 1998), an uncertainty factor of three was considered to be appropriate for ecological TRV derivation in this document. For example, a chronic or an acute TRV (e.g., 100 mg/kg BW) could be divided by an uncertainty factor of three to obtain an extrapolated NOAEL (e.g., 33 mg/kg BW). Conversely, if a NOAEL value was available, but a chronic TRV was lacking, the NOAEL TRV could be multiplied by three to extrapolate the chronic TRV (but not the acute TRV).

Risk Characterization

The risk characterization phase of an ERA consists of a quantitative estimate of the ecological risks, a description of data used in support of these risk estimates (including data gaps where appropriate), and an overall interpretation of the potential ecological impacts of each herbicide (following consideration of uncertainties in the analyses).

In order to address potential risks to ecological receptors, risk quotients (RQs) were calculated by dividing the estimated exposure concentration (EEC) for each of the previously described scenarios by the appropriate toxicity endpoint, an herbicide-specific TRV. The TRV may be a surface water or surface soil effects concentration, or a species-specific toxicity value derived from the literature.

The RQs were then compared against LOCs established by the USEPA OPP to assess potential risk to non-target organisms. These LOCs are used by the USEPA's OPP to analyze potential risk to non-target organisms and to assess the need to consider regulatory action (Table C-1). Distinct USEPA LOCs are currently defined for the following risk presumption categories:

- Acute high risk – the potential for acute risk is high.
- Acute restricted use - the potential for acute risk is high, but may be mitigated.
- Acute RTE species – RTE species may be adversely affected.

TABLE C-1
Levels of Concern

Risk Presumption		RQ	LOC
Terrestrial Animals [1]			
Birds	Acute high risk	EEC/LC_{50}	0.5
	Acute restricted use	EEC/LC_{50}	0.2
	Acute RTE species	EEC/LC_{50}	0.1
	Chronic risk	EEC/NOAEL	1
Wild mammals	Acute high risk	EEC/LC_{50}	0.5
	Acute restricted use	EEC/LC_{50}	0.2
	Acute RTE species	EEC/LC_{50}	0.1
	Chronic risk	EEC/NOAEL	1
Aquatic Animals [2]			
Fish and aquatic invertebrates	Acute high risk	EEC/LC_{50} or EC_{50}	0.5
	Acute restricted use	EEC/LC_{50} or EC_{50}	0.1
	Acute RTE species	EEC/LC_{50} or EC_{50}	0.05
	Chronic risk	EEC/NOAEL	1
	Chronic risk, RTE species	EEC/NOAEL	0.5
Plants [3]			
Terrestrial/semi-aquatic plants	Acute high risk	EEC/EC_{25}	1
	Acute RTE species	EEC/NOAEL	1
Aquatic plants	Acute high risk	EEC^2/EC_{50}	1
	Acute RTE species	EEC/NOAEL	1

[1] Estimated Environmental Concentration is in mg$_{prey\ wet\ weight}$/kg$_{BW}$ for acute scenarios and mg$_{prey\ wet\ weight}$/kg$_{BW}$/day for chronic scenarios.
[2] Estimated Environmental Concentration is in mg/L.
[3] Estimated Environmental Concentration is in lb/acre.

- Chronic risk - the potential for chronic risk is high.

A "chronic RTE species" risk presumption category for aquatic animals was added for this risk assessment. The LOC for this category was set to 0.5 to reflect a conservative 2-fold difference in contaminant sensitivity between RTE and surrogate test fishes (Sappington et al. 2001).

Risk quotients (RQs) and LOCs were tabulated and compared for all appropriate exposure scenarios and surrogate species described above. The ecological risk implications of various exposure estimates can be readily determined by noting which RQs exceed the corresponding LOCs. Over 1,000 RQs were generated in each ERA. While all RQs are presented in the supporting documentation of the risk assessment and available to BLM field offices, only selected values (e.g., those exceeding LOCs) are discussed within the text of each ERA report (ENSR 2005a-j).

Rare, Threatened, and Endangered Species

To specifically address potential impacts to RTE species, two types of RQ evaluations were conducted. For RTE terrestrial plant species, the RQ was calculated using different toxicity endpoints but keeping the same LOC (1) for all scenarios. The plant toxicity endpoints were selected to provide extra protection to RTE species. In the direct spray, spray drift, and wind erosion scenarios, the selected toxicity endpoints were an EC_{25} for "typical" species and a NOAEL for RTE species. In runoff scenarios, high and low germination NOAELs were selected to evaluate exposure for typical and RTE species, respectively.

The evaluation of RTE terrestrial animals and aquatic species was addressed using a second type of RQ evaluation. The same toxicity endpoint was used for both typical and RTE species in all scenarios, but the acute LOC was lowered for RTE species (see Table C-1).

Uncertainty Analysis

For any ERA, a thorough description of uncertainties is a key component that serves to identify possible weaknesses in the analysis and to elucidate what impact such weaknesses might have on the final risk conclusions. In general, an uncertainty analysis lists the uncertainties, followed by a logical discussion of what bias, if any, the uncertainty may introduce into the risk conclusions. This bias would be represented in qualitative terms that best describe whether the uncertainty might: 1) underestimate risk, 2) overestimate risk, 3) be neutral with regard to the risk estimates, or 4) be unable to be determined without additional study. Key categories of uncertainty for the herbicides ERAs include:

- *Limited toxicity data available for a given herbicide.* For some herbicides, the only toxicity data available may be those studies conducted as part of the USEPA pesticide registration process. In this case, chronic toxicity data may be limited or non-existent and may not include sublethal studies of importance relevant to assessment endpoint 4 (*Adverse indirect effects on the survival, growth, or reproduction of salmonids*). When relevant studies did not exist, the uncertainties were discussed as thoroughly as possible.

- *The potential indirect effects of herbicides on RTE salmonids.* Unless actual field studies were identified for a given herbicide, this discussion was limited to only qualitative estimates of potential indirect impacts on salmonid populations and communities. Such qualitative estimates were limited to a general evaluation of the potential risks to food (typically represented by acute and/or chronic toxicity to aquatic invertebrates) and cover (typically represented by potential for destruction of riparian vegetation or aquatic vegetation, if appropriate). The USEPA OPP is using similar approaches for RTE species effects determinations and consultations.[1]

- *Extrapolating from laboratory to field studies.* It is preferable to base any ecological risk analysis on reliable field studies that can clearly identify and quantify the amount of potential risk from particular exposure concentrations of the chemical of concern as field studies provide a more accurate representation of environmental conditions. When available, incident reports for the USEPA's Environmental Fate and Effects Division (EFED) were reviewed in an attempt to validate both exposure models and/or hazards to ecological receptors. For many of the new herbicides, however, such studies were not available. Most available incident reports present incomplete data, and explicit information linking herbicide exposure and resulting effects are difficult to interpret. In these cases, best professional judgment was used to evaluate the potential bias, if any, the lack of field studies had on risk conclusions. It should be noted, though, that in most cases laboratory studies actually overestimate risk relative to field studies, supporting the conservative nature of the risk assessment (Fairbrother and Kapustka 1996).

- *Ecological risks of inert ingredients, adjuvants, degradates, and tank mixtures.* From an ecological point of view, it is desirable to estimate risks not just from the a.i. of an herbicide, but also from the cumulative exposure to other ingredients. However, using currently available models (e.g., GLEAMS), deterministic risk calculations (i.e., exposure modeling, effects assessment, and RQ calculations) can only be conducted for a single a.i. However, qualitative estimates were made of the potential additional risks (if any) posed by chemicals added to the a.i. of an herbicide, such as inert ingredients (ingredients lacking active properties though still potentially toxic), adjuvants (chemicals used to enhance the pharmacological or toxic agent effect of the a.i.), and degradates (chemicals created during the natural breakdown or decomposition of another chemical).

Evaluating the potential additional/cumulative risks from mixtures of pesticides is substantially more difficult, particularly at the level of a PEIS. The composition of such mixtures is highly site-specific, and thus nearly impossible to address at the programmatic level. However, the label information from each of the 10 herbicides mentions that most can be "tank mixed" with other herbicides and insecticides. Therefore, for each herbicide, a qualitative evaluation

[1] http://www.epa.gov/oppfead1/endanger/effects

was made of the potential additional risk that might result from applying each as part of a label-approved tank mix. It should be emphasized that this evaluation was only qualitative, based on risk conclusions from existing ERAs conducted for an earlier EIS (USDI BLM 1991), for the USDA Forest Service, or by the USEPA for registration and/or re-registration. Such an analysis can only be qualitative unless reliable scientific evidence exists to suggest whether the joint action of the herbicides is additive, synergistic, or antagonistic.

- *Estimates of herbicide exposure concentrations*. As in any screening or higher-tier ERA, a discussion of potential uncertainties from fate and exposure modeling is necessary to identify potential overestimates or underestimates of risk. In particular, the uncertainty analysis focused on which environmental characteristics (e.g., soil type, annual precipitation) exert the most significant numeric impact on model outputs. The results of the uncertainty analysis have important implications about the ability to apply risk calculations to different site characteristics from a risk management point of view.

Application Methods and Herbicide Usage

Table C-2 provides herbicide usage statistics, including application sites, application methods, and application rates.

Aerial Application

Aerial application is conducted from fixed-wing planes and/or rotary helicopters in the BLM Rangeland, Public Domain Forest Land, Energy and Mineral Sites, Rights-of-way (ROW), Recreation, and Aquatics programs. ERA modeling assumed that herbicides were applied with buffers of 100, 300, and 900 feet (ft) from evaluated receptors, and application heights varied depending on whether the application area was forested or not.

Ground Application

Ground applications take place in the BLM Rangeland, Public Domain Forest Land, Energy and Mineral Sites, ROW, Recreation, and Aquatics programs. Applications are conducted on foot or horseback using backpack sprayers or from vehicles (truck, all-terrain vehicle [ATV], boat) using spot or boom/broadcast (low or high boom) methods. For modeling purposes, herbicides were applied with buffers of 25, 100, and 900 ft from evaluated receptors.

Aquatic Application

There are four zones in a body of water that may be treated for the management of aquatic weeds: water surface, total water volume, bottom 1 to 3 ft of water, and the bottom soil surface.

When working in the water surface zone, generally only a fourth to a third of the surface area is treated at a time. Applications are made to floating or emergent weeds with the spray mixture being applied directly to the plants. When treating the total water volume, applications can be made through the metering or injecting of the herbicide into the water from booms trailing behind the boat or as a spray over the water surface. Applications of this type are made to submersed aquatic plants and algae. Treatments to the deepest 1 to 3 ft of water are generally made by attaching several flexible hoses at specific intervals on a rigid boom. Each hose is equipped with a nozzle and may be weighted to reach the depth desired. The length of hose and the speed of the boat carrying the application equipment also affect the depth of application. Such applications are beneficial because they apply the herbicide in a layer nearer the area where the herbicide can be taken up by the weedy species. The final zone, bottom soil surface, refers to applications made to the bottom soil of a drained pond, lake, or channel.

To treat small areas, a compressed-air sprayer with a hand-operated pump may be all that is needed. For larger areas, a boat-mounted pump-and-tank rig with one line may be used to treat emergent plants on a spot treat basis. A boom attached to the boat may be used when broadcast applications are made to the surface of the water, and booms with flexible hoses attached to the boom may be used to make the application below the water surface. Applications of granules and slow-release pellets can be made either using a cyclone spreader or by hand. The granules sink to the bottom, where the chemical is slowly released in the relatively small volume of water where the new shoots are beginning to grow.

Floating and emergent vegetation in static water (i.e., water in ponds, lakes, or reservoirs that have little or

TABLE C-2
Herbicide Application Methods and Usage Statistics

Herbicide	Programs/Treatment Areas	Application Method	Application Rate (lbs. a.i./acre)	
			Typical	Maximum
Bromacil	Energy and mineral sites Rights-of-way Recreation	Backpack, horseback, ATV, and truck (spot, boom/broadcast)	4.0	12.0
Chlorsulfuron	Rangeland Energy and mineral sites Rights-of-way Recreation	Plane, helicopter backpack, horseback, ATV, and truck (spot, boom/broadcast)	0.047	0.062
Diflufenzopyr	Rangeland Energy and mineral sites Rights-of-way Recreation	Backpack, horseback, ATV, and truck (spot, boom/broadcast)	0.075	0.1
Diquat	Aquatic	Plane, helicopter backpack, horseback, ATV, and truck (spot, boom/broadcast)	1.0	4.0
Diuron	Energy and mineral sites Rights-of-way Recreation	Backpack, horseback, ATV, and truck (spot, boom/broadcast)	6.0	20.0
Fluridone	Aquatic	Plane, helicopter backpack, horseback, ATV, and truck (spot, boom/broadcast)	0.15	1.3
Imazapic	Rangeland Public domain forestland Energy and mineral sites Rights-of-way Recreation	Plane, helicopter backpack, horseback, ATV, and truck (spot, boom/broadcast)	0.0313	0.1875
Overdrive®	Rangeland Oil and gas Rights-of-way Recreation	Backpack, horseback, ATV, and truck (spot, boom/broadcast)	0.2625	0.35
Sulfometuron methyl	Public domain forestland Energy and mineral sites Rights-of-way Recreation	Helicopter Backpack, horseback, ATV, and truck (spot, boom/broadcast)	0.14	0.38
Tebuthiuron	Rangeland Energy and mineral sites Rights-of-way Recreation	Plane, helicopter backpack, horesback, ATV, and truck (spot, boom/broadcast)	0.5	4.0

no inflow and outflow) is managed by direct foliage applications of the spray mixture by aircraft, with ground equipment operated from the bank if the pond is small or if the weeds occur only around the margins, or from a boat using various types of booms or hand applicators.

Aquatic vegetation in flowing water is more difficult to manage. Floating and emergent vegetation, when treated in flowing water, require the same treatment techniques as they do in the static water. Submersed vegetation and algae can be controlled effectively in flowing water only by continuously applying enough herbicide at a given spot to maintain the needed concentration and contact time.

Non-target Species Exposure Characterization

As described earlier, a number of exposure scenarios were developed to address potential acute and chronic impacts to receptors under a variety of exposure conditions that may occur within public lands. These exposure conditions include normal application situations, accidental spills, and associated off-site transport via spray drift, windblown dust, or surface runoff and root-zone groundwater. In general, the exposure scenarios describe how a particular receptor group (e.g., terrestrial animals, terrestrial plants, aquatic plants) may be exposed to an herbicide in a complete exposure pathway. The selected pathways and relevant dose calculations are described in more detail in the following sections.

This section discusses the exposure of terrestrial and aquatic receptors to the 10 herbicides proposed for new and continued use on public lands in 17 western states. The processes of surrogate species selection and the calculation of exposure data based on species biology and herbicide application rates are presented below.

Ecological Receptors

Surrogate Species

Use of surrogate species in a screening ERA is necessary to address the broad range of species likely to be encountered on public lands as well as to accommodate the fact that toxicity data may be restricted to a limited number of species. In this ERA, surrogates were selected to account for variation in the nature of potential herbicide exposure (e.g., direct contact, food chain) as well as to ensure that different taxa and their behaviors were considered. Generally, the surrogate species that were used in the ERAs are species commonly used as representative species in ecological risk assessments. Many of these species are common laboratory species, or are described in the USEPA (1993a, b) *Wildlife Exposure Factors Handbook*. Other species were included in the California Wildlife Biology, Exposure Factor, and Toxicity Database (California Office of Environmental Health Hazard Assessment [CA OEHHA] 2003), or are those recommended by USEPA OPP for tests to support pesticide registration.

Toxicity data from surrogate species were used in the development of TRVs. The surrogate species used for development of TRVs in each herbicide ERA are presented in Table C-3. For vertebrate terrestrial animals, in addition to these surrogate species, specific species were selected to represent populations of similar species (Table C-4). Interspecies extrapolation of toxicity data often produces unknown bias in risk calculations; therefore, higher trophic-level species were grouped according to shared life-history traits (e.g., herbivore vs. carnivore). Whenever possible, the species selected are found throughout the range of land included in the PEIS; all species selected are found in at least a portion of the range. The surrogate species are common species whose life histories are well documented (USEPA 1993a, b; CA OEHHA 2003). Because species-specific data, including body weight and food ingestion rates, can vary for a single species throughout its range, data from studies conducted in western states or with western populations were selected preferentially. This life-history procedure was not done for plants, invertebrates, and fish, as most exposure of these species to herbicides is via direct contact (e.g., foliar deposition, dermal deposition, dermal/gill uptake) rather than ingestion of contaminated prey items. Therefore, altering the life history of these species would not result in more or less exposure. In addition, potential impacts to non-target terrestrial plants were considered by evaluating two non-target plant receptors: the "typical" (i.e., non-RTE) species and the RTE species.

Very few laboratory studies have been conducted using reptiles or amphibians. Therefore, data specific to the adverse effects of a chemical on species of these taxa are often unavailable. These animals, being cold-blooded, have very different rates of metabolism than mammals or birds (i.e., they require lower rates of

TABLE C-3
Surrogate Species Used in Quantitative ERA Evaluations

Surrogate Species	Scientific Name	Receptor	Herbicide
Honeybee	*Apis mellifera*	Pollinating insects	Bromacil, chlorsulfuron, diflufenzopyr, diquat, diuron, fluridone, imazapic, sulfometuron methyl, and tebuthiuron
Mouse	*Mus musculus*	Mammals	Bromacil, diquat, fluridone, sulfometuron methyl, and tebuthiuron
Rat	*Rattus norvegicus* spp.	Mammals	Bromacil, chlorsulfuron, diflufenzopyr, diquat, diuron, fluridone, imazapic, sulfometuron methyl, and tebuthiuron
Dog	*Canis familiaris*	Mammals	Bromacil, chlorsulfuron, diflufenzopyr, diquat, diuron, fluridone, imazapic, sulfometuron methyl, and tebuthiuron
Rabbit	*Leporidae* sp.	Mammals	Bromacil, chlorsulfuron, diflufenzopyr, diquat, diuron, fluridone, imazapic, sulfometuron methyl, and tebuthiuron
Guinea pig	*Cavia* sp.	Mammals	Chlorsulfuron
Mallard	*Anas platyrhynchos*	Birds	Bromacil, chlorsulfuron, diflufenzopyr, diquat, diuron, fluridone, imazapic, and sulfometuron methyl
Bobwhite quail	*Colinus virginianus*	Birds	Bromacil, diflufenzopyr, diquat, diuron, sulfometuron methyl, and tebuthiuron
Ring-necked pheasant	*Phasianus colchicus*	Birds	Diquat, fluridone, and imazapic
Japanese quail	*Coturnix coturnix*	Birds	Diquat
Chicken	*Gallus gallus*	Birds	Tebuthiuron
Rape	*Orobanche* sp.	Non-target terrestrial plants	Bromacil
Soybean	*Glycine max*	Non-target terrestrial plants	Bromacil, diuron, and imazapic
Canola	*Brassica napus L.*	Non-target terrestrial plants	Chlorsulfuron
Dyer's woad (weed)	*Isatis tinctoria*	Non-target terrestrial plants	Chlorsulfuron
Turnip	*Brassica rapa*	Non-target terrestrial plants	Diflufenzopyr
Tomato	*Lycopersicon esculentum*	Non-target terrestrial plants	Diflufenzopyr and diuron
Corn	*Zea mays*	Non-target terrestrial plants	Diquat and imazapic
Garden pea	*Pisum sativum*	Non-target terrestrial plants	Diuron
Vegetative crop	9 species, monocots and dicots	Non-target terrestrial plants	Imazapic
Onion	*Allium cepa*	Non-target terrestrial plants	Imazapic
White mustard	*Sinapis alba L.*	Non-target terrestrial plants	Sulfometuron methyl
Leafy spurge	*Euphorbia esula*	Non-target terrestrial plants	Sulfometuron methyl
Sorghum	*Sorghum bicolor*	Non-target terrestrial plants	Sulfometuron methyl
Sugarbeet	*Beta vulgaris*	Non-target terrestrial plants	Sulfometuron methyl
Cabbage	*Brassica* sp.	Non-target terrestrial plants	Tebuthiuron
Daphnid	*Daphnia magna*	Aquatic invertebrates	Bromacil, chlorsulfuron, diflufenzopyr, diquat, imazapic, and sulfometuron methyl
Daphnid	*Ceriodaphnia dubia*	Aquatic invertebrates	Sulfometuron methyl and tebuthiuron
Scud	*Gammarus fasciatus*	Aquatic invertebrates	Diuron
Amphipod	*Hyalella azteca*	Aquatic invertebrates	Diquat
Midge	*Chironomus tentans*	Aquatic invertebrates	Fluridone
Snail	*Helisoma* and *Physa* spp.	Aquatic invertebrates	Tebuthiuron

TABLE C-3 (Cont.)
Surrogate Species Used in Quantitative ERA Evaluations

Surrogate Species	Scientific Name	Receptor	Herbicide
Fathead minnow	*Pimephales promelas*	Fish	Bromacil, diuron, sulfometuron methyl, and tebuthiuron
Channel catfish	*Ictalurus punctatus*	Fish	Chlorsulfuron
Bluegill sunfish	*Lepomis macrochirus*	Fish	Diflufenzopyr and tebuthiuron
Walleye	*Stizostedion vitreum*	Fish	Diquat
Brown trout	*Salmo trutta*	Fish/salmonids	Chlorsulfuron
Rainbow trout	*Oncorhynchus mykiss*	Fish/salmonids	Bromacil, diflufenzopyr, diquat, fluridone, imazapic, and sulfometuron methyl
Cutthroat trout	*Oncorhynchus clarki*	Fish/salmonids	Diuron
Sago pondweed	*Potamogeton pectinatus*	Non-target aquatic plants	Chlorsulfuron
American pondweed	*Potamogeton nodosus*	Non-target aquatic plants	Fluridone
Green algae	*Selanastrum capricornutum*	Non-target aquatic plants	Bromacil, diflufenzopyr, diuron, and tebuthiuron
Algae	*Chlorella pyrenoidosa*	Non-target aquatic plants	Diuron
Duckweed	*Lemna* sp.	Non-target aquatic plants	Diquat and imazapic
Macrophyte	*Myriophyllum sibiricum*	Non-target aquatic plants	Sulfometuron methyl

TABLE C-4
Vertebrate Surrogate Species Evaluated by Life History

Species	Scientific Name	Trophic Level/Guild	Pathway Evaluated
American robin	*Turdus migratorius*	Avian invertivore/vermivore/ insectivore	Ingestion
Canada goose	*Branta canadensis*	Avian granivore/herbivore	Ingestion
Deer mouse	*Peromyscus maniculatus*	Mammalian frugivore/herbivore	Direct contact and ingestion
Mule deer	*Odocolieus hemionus*	Mammalian herbivore/gramivore	Ingestion
Bald eagle (northern)	*Haliaeetus leucocephalus alascanus*	Avian carnivore/piscivore	Ingestion
Coyote	*Canis latrans*	Mammalian carnivore	Ingestion

food consumption). Nonetheless, mammals and birds were used as the surrogate species for reptiles and adult amphibians because of the lack of data for these taxa (fish were used as surrogates for juvenile amphibians).

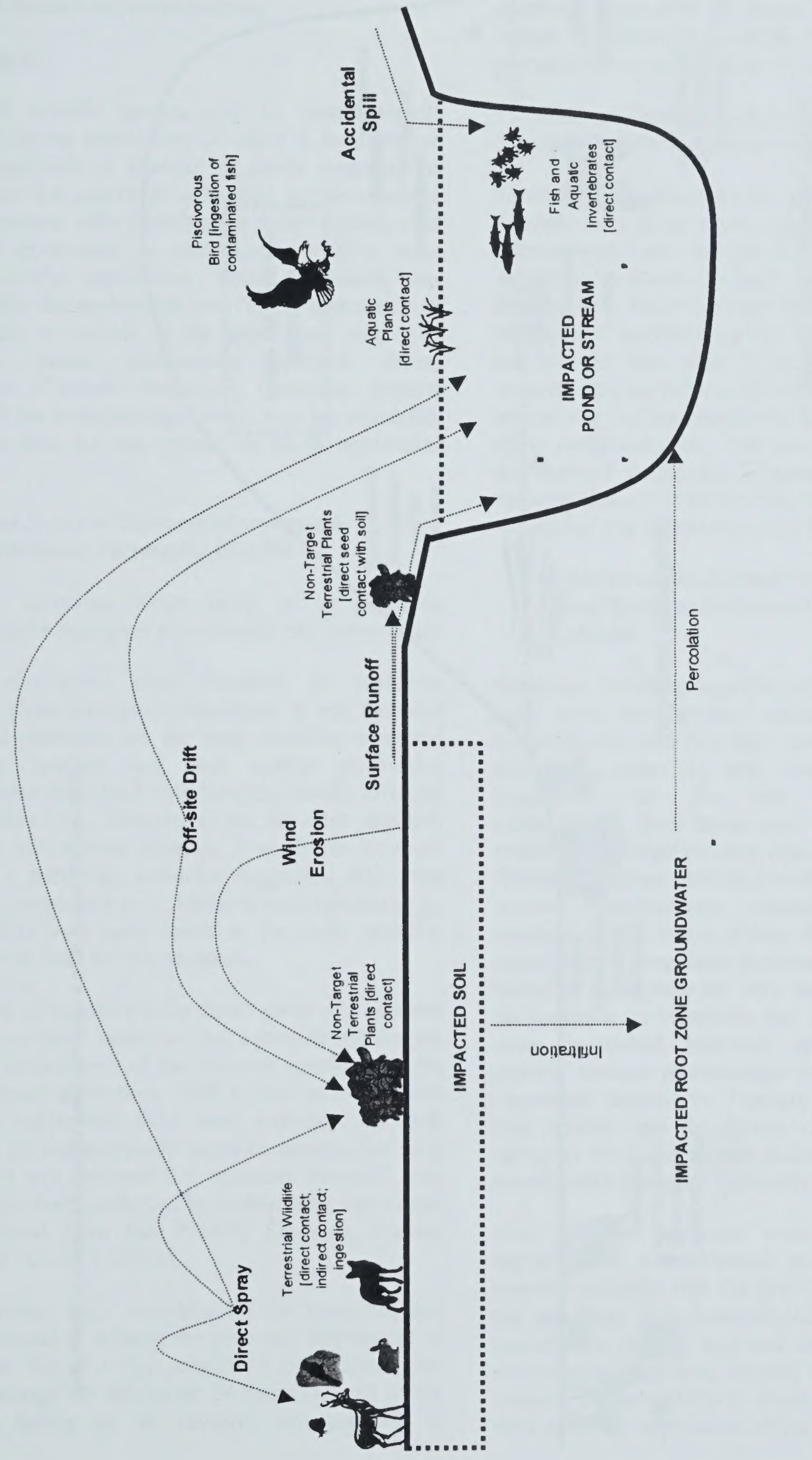
Aquatic exposure pathways were evaluated using fish, aquatic invertebrates, and non-target aquatic plants for two types of generic aquatic habitat: 1) a small pond ¼-acre in area, 1 meter (m) in depth, and 1,011,715 liters (L) in volume and 2) a small stream representative of Pacific Northwest low-order streams that provide habitat for critical life-stages of anadromous salmonids (the stream is defined as 2 m-wide and 0.2-m deep, with a mean water velocity of approximately 0.3 m per second, resulting in a base flow discharge of 0.12 cubic meters per second [cms]).

Exposure Pathways

The following is a brief description of the scenarios used to address potential impacts to non-target organisms both within the area where the herbicide is being applied and outside the application area (accidental exposures not typical of BLM practices). Conceptual models were developed that provide working hypotheses about how terrestrial (Figure C-1)

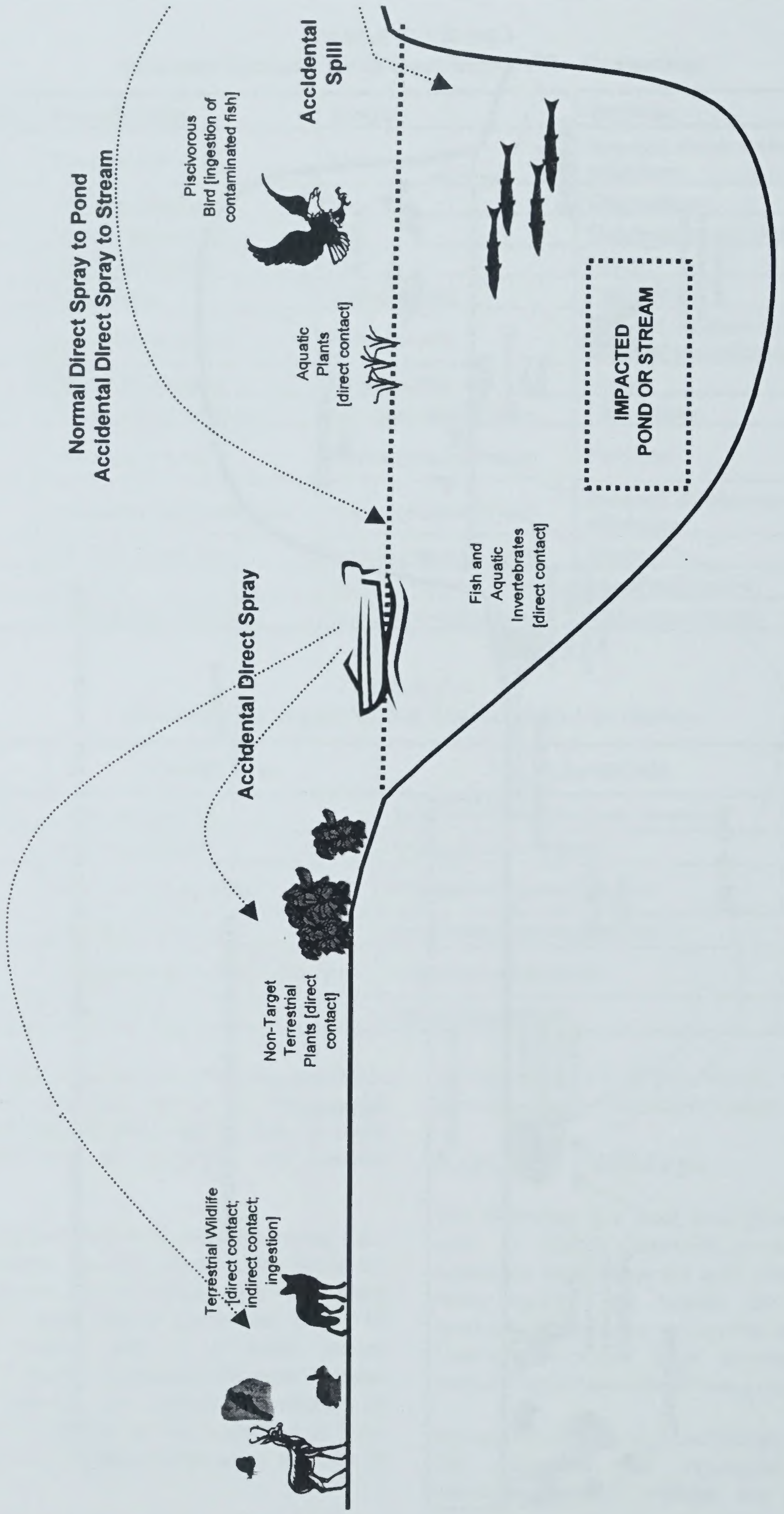
and aquatic (Figure C-2) herbicides might pose risk to the ecosystem and ecological receptors. The conceptual models indicate the possible exposure

FIGURE C-1. Conceptual Model for Terrestrial Herbicides.



Application of terrestrial herbicides may occur by aerial (i.e., plane, helicopter) or ground (i.e., truck, backpack) methods.

FIGURE C-2. Conceptual Model for Aquatic Herbicides.



Application of aquatic herbicides may occur from a boat or from the shoreline.

pathways for the herbicides, as well as the receptors evaluated for each exposure pathway.

Direct Spray

Plant and wildlife species may be unintentionally impacted during application of either a terrestrial or aquatic herbicide as a result of direct spray of the receptor or the waterbody inhabited by the receptor, indirect contact with dislodgeable foliar residue after herbicide application, or consumption of prey items sprayed during application. These exposures may occur within the application area (e.g., consumption of prey items) or outside of the application area (e.g., terrestrial plants accidentally sprayed during application of aquatic herbicide). Generally, impacts outside of the intended application area are accidental exposures that are not typical of BLM application practices.

Direct Spray of Terrestrial or Aquatic Herbicide on Terrestrial Wildlife

Scenarios involving direct spray of an herbicide consider acute exposures of vertebrate and invertebrate species considered most sensitive to herbicide exposure under laboratory conditions. It was assumed that small mammals are the most sensitive terrestrial vertebrate species, and that mobile pollinating invertebrates that spend time foraging among different plant species (e.g., honeybees) are the most sensitive terrestrial invertebrate receptor. If available literature data for a particular herbicide suggested that other terrestrial vertebrates (e.g., birds) or invertebrates (e.g., earthworms) were more sensitive, the more sensitive receptor was used for this scenario.

The extent of exposure from direct spray of a receptor is based on three variables: the herbicide application rate, the surface area of the receptor species, and the rate of dermal absorption. Both typical and maximum herbicide application rates were evaluated for each herbicide for representative sensitive species. For each receptor it was assumed that exposure occurred over one-half the body surface. The surface area calculation was obtained from the *Wildlife Exposure Factors Handbook* (USEPA 1993a).

Two scenarios were evaluated for the honeybee and small mammal to address the potential differences in absorption. The first case considered 100% absorption (intake through the skin) over 24 hours (i.e., all of the herbicide falling on the receptor was assumed to penetrate the skin). The second scenario considered the absorbed dose over 24 hours assuming first order dermal absorption (i.e., taking into consideration the potential for some herbicide to not be absorbed).

Indirect Contact with Foliage after Direct Spray of Terrestrial or Aquatic Herbicide

Scenarios involving direct spray of an herbicide consider only acute exposures. Foliage that has been sprayed with herbicide may transfer this herbicide to terrestrial animals through dermal contact with dislodgeable foliar residue. However, there is little information available on the potential magnitude of this transfer from plant to animal. Therefore, it was assumed that the amount of herbicide transferred to the animal was $^1/_{10}$ the amount the animal received during direct spray scenarios. This assumption was based on the work of Harris and Solomon (1992). It was also assumed that all herbicide transferred to the outside of the animal was completely adsorbed within 24 hours.

Ingestion of Food Items Contaminated by Direct Spray of Terrestrial or Aquatic Herbicide

Scenarios involving ingestion of food items consider both acute and chronic exposures. The terrestrial receptors considered for these scenarios included small and large mammals and small and large birds. Ingestion rates for the species consuming contaminated food items were obtained from field studies based on allometric equations presented in the *Wildlife Exposure Factors Handbook* (USEPA 1993a). It was conservatively assumed that the exposed receptors obtain 100% of their diet from the herbicide contaminated prey items and that 100% of the applied herbicide drifts onto the prey item. Concentrations of the herbicide on vegetation and insects were predicted using individual herbicide application rates and generic residue relationships for different types of vegetation derived by Hoerger and Kenaga (1972). The residue rate for forage crops was used as a surrogate for contaminated insects. Residue rates were not available for small mammals.

Two exposure scenarios were considered for the ingestion of contaminated prey items. The first scenario assumes that the prey item is consumed on the same day it is contaminated with herbicide (no degradation period). Ingested doses for this scenario were compared to acute toxicity endpoints. The second scenario assumes the prey is consumed up through 90 days after the application of the herbicide. Assuming

first-order decay rates, the herbicide dose is predicted as a time-weighted average of the herbicide mass on the foliage over the 90-day period. This dose is compared to chronic toxicity endpoints.

Direct Spray of Terrestrial or Aquatic Herbicide on Non-target Terrestrial Plants

In the direct spray scenario, a non-target plant is sprayed during normal application of the terrestrial herbicide. Unintended direct spray of a non-target receptor is considered an accidental exposure scenario that is not typical of BLM application practices. The typical and maximum application rates were used to represent the amount accidentally sprayed on the non-target species. These application rates were directly compared to appropriate toxicity endpoints to determine potential impacts to non-target typical and RTE plants.

Direct Spray of Terrestrial or Aquatic Herbicide onto Pond

The normal application of aquatic herbicides to a pond was considered to evaluate potential impacts to aquatic receptors other than the target plant species. For this scenario, the typical and maximum application rates of the herbicides were applied directly to the pond, and the associated water concentration was calculated based on the pond area and volume. Neither degradation nor sorption of the herbicide to sediments, aquatic vegetation, or suspended solids was considered, resulting in a conservative estimate of the herbicide concentration in pond water. The pond water concentrations were compared against appropriate acute and chronic toxicity endpoints to evaluate potential impacts to fish, aquatic invertebrates, and non-target aquatic plants.

Accidental Direct Spray of Terrestrial or Aquatic Herbicide onto Stream

Aquatic and terrestrial herbicides may be accidentally directly sprayed onto the surface of a stream (stream plants are not targeted with herbicide applications). The typical and maximum application rates of the herbicides were applied directly to the stream, and the associated water concentrations were calculated. Degradation and sorption of the herbicide and transport from flow of the stream were not considered, and therefore, this represents a conservative calculation of the stream water concentration (essentially an instantaneous concentration). The stream concentrations were compared against appropriate acute and chronic toxicity endpoints to evaluate potential impacts to fish, aquatic invertebrates, and non-target aquatic plants.

Off-site Drift

During normal application of herbicides, it is possible for a portion of the herbicide to drift outside of the treatment area and deposit onto non-target receptors. Off-site spray drift and resulting terrestrial deposition rates and waterbody (pond and stream) concentrations were predicted using the computer model AgDRIFT® Version 2.0.05. AgDRIFT® is a product of the Cooperative Research and Development Agreement between the USEPA's Office of Research and Development and the Spray Drift Task Force (SDTF; a coalition of pesticide registrants). It is based on, and represents an enhancement of, the computer program for agricultural dispersion (AGDISP). AGDISP was developed by the National Aeronautics and Space Administration (NASA), the USDA Forest Service, and the U.S. Army. AgDRIFT® was developed for use in regulatory assessments of off-site drift associated with agricultural use of pesticides through aerial, ground, or orchard/airblast applications. AgDRIFT® is based upon the idea that pesticide or herbicide drift is primarily a function of application technique (e.g., droplet size and release height), environmental conditions, and physical properties of the spray solution, and is not a function of the chemical properties of the a.i. itself. The computational approach employed by AgDRIFT® is based on a method that has evolved over a period of more than 20 years, and yields high correlation with field measurement data sets. The model was selected for use in this risk assessment because of its existing use in regulatory assessments of off-target drift and its suitability to this particular application.

AgDRIFT® enables the user to take a tiered approach to the modeling of drift by allowing the user to choose between three tiers (Tiers I, II, and III) of increasingly complex evaluations of off-target drift and deposition. The basic difference between the three tiers is the number of model input variables the users can change. Further, Tier I supports the evaluation of aerial and ground application scenarios, whereas Tiers II and III only support the evaluation of aerial application scenarios (agricultural and forestry applications). Tier I is based on a set of standard "Good Application Practices," requires little knowledge of the actual application conditions or herbicide properties, and allows the user to modify a small number of model variables. Tiers II and III are based on the same set of

"Good Application Practices"; however Tiers II and III allow the user to modify variables to make the scenario evaluated representative of the conditions under which herbicides will be applied. Tier I was used in the ERAs to evaluate off-site drift associated with ground application scenarios, and Tier II was used to evaluate off-site drift associated with agriculture-like (e.g., rangeland) and forestry application scenarios. The implementation of the Tier I ground and Tier II aerial application model and the model input variables (including the variables specific to the application method and environmental setting and specific to the herbicide being evaluated) are discussed and presented in Appendix A of the Methods document (ENSR 2004).

In accordance with actual BLM herbicide practices, ground application scenarios were modeled using a low- or high-placed boom. Aerial application scenarios were modeled from either a helicopter or a plane at two different heights representing forested or non-forested land types. Drift depositions were estimated at 25, 100, and 900 ft from the application area for ground applications and at 100, 300, and 900 ft for aerial applications. The AgDRIFT® model determined the fraction of the application rate that would be deposited on the off-site location without considering herbicide degradation.

Off-site Drift of Terrestrial Herbicide onto Plants

Surface soil concentrations calculated by AgDRIFT® were directly compared against appropriate toxicity endpoints to determine potential impacts to non-target typical and RTE plants.

Off-site Drift of Terrestrial Herbicide onto Pond or Stream

During normal application, is possible for a portion of the terrestrial herbicide to drift outside of the treatment area. This off-site drift may eventually reach a pond or stream and contaminate the waterbody. AgDRIFT® was used to calculate pond and stream water concentrations of the herbicide in the various application scenarios. The waterbody concentrations calculated by AgDRIFT® do not consider herbicide degradation, sorption, or dissipation, and likely overestimate actual concentrations. AgDRIFT® does consider the dilution of the herbicide in the volume of the pond, but the rate of deposition estimated by AgDRIFT® was diluted into the stream based on the assumed flow rate.

The predicted surface water concentrations in the pond and stream as a result of the various application scenarios were compared to the appropriate acute and chronic toxicity endpoint for each of the three aquatic receptors.

Consumption of Fish from Pond Contaminated by Off-site Drift of Terrestrial Herbicide

Off-site drift of herbicide may eventually reach off-site ponds and contaminate the resident fish population, which may be consumed by piscivorous bird species. In this scenario, impacted pond water is modeled using AgDRIFT® input variables described above. Exposure for the piscivorous bird was evaluated by modeling fish tissue concentrations from pond surface water (C_{pond}) employing bioconcentration factors and food chain multipliers for different trophic levels. Food chain multipliers assumed a trophic level 3 for fish and a trophic level 2 for the prey of fish (e.g., aquatic invertebrates). FCMs were obtained from USEPA (1995a).

The calculated dose to the piscivorous bird is a function of the concentration in the fish tissue, the food ingestion rate in wet weight, the proportion of the diet that is contaminated (assumed to be 100%), and the body weight of the bird. The dose estimate to the piscivorous bird was compared to appropriate chronic toxicity values.

Surface Runoff

Precipitation may result in the transport of herbicide applied to soils from the application area via surface runoff and root-zone groundwater flow. GLEAMS was used in this risk assessment to calculate soil concentrations at the site of application, transport of herbicides to adjacent soils, and the amount of herbicide that might runoff into aquatic habitats (e.g., ponds, streams). One benefit of GLEAMS is the ability to estimate a wide range of potential herbicide exposure concentrations as a function of site-specific parameters, such as soil characteristics and annual precipitation.

GLEAMS Overview

GLEAMS is a modified version of the CREAMS (Chemical Runoff Erosion Assessment Management System) model that was originally developed to evaluate non-point source pollution from field-size areas. Specifically, the hydrology, plant nutrient, and pesticide components of the CREAMS model were

modified to consider movement of water and chemicals within and through the root zone. These modifications allow the GLEAMS model to simulate edge-of-field and bottom-of-root-zone loadings of water, sediment, pesticides, and plant nutrients from the complex climate-soil-management interactions. Agricultural pesticides are simulated by GLEAMS using three major components:

- *Hydrology* – considers the effects of precipitation, surface runoff, and percolation through the unsaturated zone of the soil and simulates the effects of vegetation on surface water runoff, infiltration, and evapotranspiration.

- *Erosion* – considers the movement of sediment over the land surface using the Universal Soil Loss Equation (USLE) and pesticide loss associated with particle erosion.

- *Pesticide* – considers chemical-specific characteristics (e.g., soil adsorption, decay) and application methods to determine the amount of herbicide that is available for extraction into surface runoff and/or movement into the soil profile and groundwater.

The GLEAMS model has evolved through several versions from its inception in 1984 to the present, and it has been evaluated in numerous climatic and soil regions around the world. The model was selected for use in this investigation because of its widespread acceptance, its suitability to this particular application, and the previous use of the model to support similar risk assessments for the USDA Forest Service (e.g., SERA 2003).

Data Requirements. The information required for a GLEAMS simulation includes a wide variety of site-specific data to describe the climate, topography, subsurface soils, vegetation type and growing potential, and herbicide-specific properties. The following briefly describes a subset of the data required to successfully simulate the effects of an herbicide on an agricultural site using GLEAMS:

- *Precipitation* – Daily rainfall records for the entire simulation period are required to provide input to the hydrologic simulation. The volume of precipitation strongly influences the amount of runoff and percolation of associated herbicides.

- *Climate* – Daily averages of standard meteorological data are necessary to define precipitation as either rain or snow and to calculate variations in monthly evapotranspiration. Because evapotranspiration is a large component of the hydrologic cycle, the climate (e.g., temperature, humidity) can affect the volume of water moving through the application area.

- *Soil characteristics* – Soil characteristics (as identified by soil type) are applied to the GLEAMS model to facilitate the calculation of runoff and percolation from the application area.

- *Vegetation/ground cover* – Plant growth controls the partitioning of pesticide to either the soil or foliar surfaces and controls the rate of evapotranspiration.

- *Herbicide properties* – The varying distribution of pesticide concentrations predicted by GLEAMS in an agricultural system is largely dependent on the chemical-specific properties used in the model, such as sorption coefficients and decay rates. As these values are herbicide-specific and can vary significantly, concentrations predicted by GLEAMS can be quite different among herbicides.

GLEAMS Model Scenarios

The GLEAMS model was run using a variety of model inputs designed to simulate a broad range of representative environmental conditions. The effect of changing environmental conditions on the export of herbicide from an application area was assessed in two distinct phases:

- *Variable soil type and annual precipitation* – The effects of soil type and cumulative annual precipitation were investigated by developing a single realistic GLEAMS scenario (base case) and then varying these two components. Soil type and precipitation were selected for the first phase of the modeling application because they are the factors most likely to affect the outcome of a simulation. The model was used to calculate herbicide export in environments with the three soil types (sand, loam, and clay) assuming annual precipitation rates of 5, 10, 25, 50, 100, 150, 200, and 250 inches (in). In

total, there were 24 simulation combinations in this first phase of the modeling application.

- *Variable physical characteristics* – The effect of varying six physical parameters (soil type, soil erodibility factor, size of application area, hydraulic slope, surface roughness, and vegetation type) was investigated by changing each parameter individually. There were three variations for each of the six parameters, resulting in 18 simulations in this second phase of the modeling application.

The combination of scenarios included in each of the two phases of GLEAMS modeling produced results for 42 simulations. These simulations provide an indication of the effects of a variety of environmental conditions on the export of herbicide to off-site receptors. These scenarios were used to predict herbicide concentrations in soil and in the surface water of a stream and a pond.

The GLEAMS model predicts daily herbicide export rates. Because conservative assumptions were used in the model, it is likely that the export rates predicted by GLEAMS are high. This is substantiated by the comparison of the GLEAMS export rates modeled here to measured data presented by Lerch and Blanchard (2003), where GLEAMS export rates were higher than measured rates. Details of this comparison are presented in Appendix B of the ERA Methods document (ENSR 2004).

The daily export rates were used to calculate both surface soil and ambient water concentrations. The predicted runoff and percolation rates, and the mass of herbicide associated with each of these exports, were used to determine the amount of herbicide deposited at the edge of the application area.

The soil concentrations were calculated as 52, 7-day average concentrations from the final year of the GLEAMS run (when the model reaches a quasi-steady state). Ambient water concentrations were calculated using GLEAMS model daily predictions of herbicide export rates for acute and chronic exposure scenarios in a river and a pond immediately adjacent to the application area. Acute exposure scenario concentrations were calculated from the maximum 3-day average herbicide export rate from the last year of the simulation. Chronic exposure scenario concentrations were calculated from the daily average herbicide export rate from the last year of the simulation.

The following subsections present a general overview of the calculation of media concentrations in a variety of different terrestrial exposure scenarios (the surface runoff scenarios are not considered relevant for the aquatic herbicides). A more detailed discussion (including assumptions and equations) is presented in Appendix B of the ERA Methods document (ENSR 2004). Each herbicide risk assessment (ENSR 2005a-j) contains an herbicide-specific description of the model outputs.

Surface Runoff of Terrestrial Herbicide to Off-site Soils

The maximum of the 7-day average loadings calculated by GLEAMS was assumed to affect a soil area immediately downslope of the application area. The loading was expressed as a proportion of the total herbicide loading to the application area. For example, if 30% of the applied herbicide was found to run off, the soil concentration off-site was predicted to be 30% of that in the application area. These off-site soil concentrations were compared against appropriate toxicity endpoints to determine potential impacts to non-target typical and RTE plants. This particular exposure pathway may impact seed germination; therefore, toxicity data relevant to seed germination, a sensitive endpoint, were used for evaluation.

Overland Flow of Terrestrial Herbicide to Off-site Pond and Stream

As described previously, precipitation may result in the transport of terrestrial herbicides via surface runoff and root-zone groundwater flow. This overland flow of herbicide applied to soil (via runoff and groundwater) may eventually reach an off-site pond or stream resulting in the contamination of the waterbody. The daily predictions of herbicide export rates from the GLEAMS model were used to calculate ambient water concentrations of herbicide in the various watershed scenarios. GLEAMS considers the subsequent runoff and the natural decay processes that reduce the ambient pond water concentrations over time. Pond concentrations were calculated by assuming a fixed pond volume and a daily inflow of mass and water to the pond depending on recent precipitation, runoff, and percolation characteristics. The GLEAMS exports were used to calculate two pond and two stream water concentrations for comparison against acute and chronic toxicity endpoints for each of the three aquatic receptor groups.

Consumption of Fish from Pond Contaminated by Surface Runoff of Terrestrial Herbicide

Surface runoff containing herbicide bound to soil may eventually reach an off-site pond, and resident fish may uptake herbicide. The fish, in turn, may be consumed by piscivorous bird species. In this scenario, impacted pond water was modeled using the GLEAMS model described above. Since bioaccumulation is a long-term process, the chronic exposure concentration (i.e., the overall average concentration from the final year of the GLEAMS run) was used to predict fish tissue concentrations. A bioconcentration factor and food chain multipliers for different trophic levels were included in the estimate. Food chain multipliers assumed a trophic level 3 for fish and a trophic level 2 for the prey of fish (e.g., aquatic invertebrates). Food chain multipliers were obtained from USEPA (1995a). The calculated dose to the piscivorous bird is a function of the concentration in the fish tissue, the food ingestion rate in wet weight, the proportion of the diet that is contaminated (assumed to be 100%), and the body weight of the bird.

Wind Erosion and Off-site Transport of Terrestrial Herbicide

Dry conditions and wind may also allow transport of herbicide from the application area as wind-blown soil (fugitive dust) onto non-target plants some distance away. This transport due to wind erosion of the surface soil was modeled using the USEPA's guideline air quality CALPUFF air pollutant dispersion model (referenced in Appendix W of 40 CFR Part 51; see the *Air Quality Modeling for BLM Vegetation Treatment Methods* report ["Air Quality Modeling report;" ENSR 2005k] for CALPUFF details and assumptions). CALPUFF "lite" version 5.7 was selected because of its ability to screen potential air quality impacts within and beyond 50 kilometers (km; 31 miles) and its ability to simulate plume trajectory over several hours of transport based on limited meteorological data. Three distinct watersheds were modeled using CALPUFF to determine herbicide concentrations in particulate matter assumed to deposit on plants (i.e., total suspended particulates [TSPs] ranging between 0.1 and 50 micrometers [µm] in diameter, particulate matter [PM] 2.5 µm in diameter and smaller [$PM_{2.5}$], and PM_{10} µm in diameter and smaller). The concentrations were modeled after a wind event, with dust deposition estimates calculated at distances ranging from 1.5 to 100 km (0.9 to 62 miles) from the application area. At each radius considered, the maximum predicted rate of herbicide deposition in a given wind event was calculated. The dust estimates calculated within the model were then compared against the appropriate non-target plant toxicity values.

The dust exposure scenario was not considered for aquatic herbicides.

Source Characterization

A high wind event may cause the surface soil (with the applied herbicide) to migrate from the application area, and in this modeled event, CALPUFF determines the rate of herbicide deposition as a function of the rate of dust deposition at the downstream receptor location. It was assumed that all of the applied herbicide was adsorbed by the top 1 mm (0.04 in) of soil. The depth of 1 mm is believed to be conservative (thinner affected soil depths result in elevated herbicide emissions during fugitive dust events), and is less that that assumed by others (e.g., SERA [2003] assumed 1 cm; 0.4 in). The modeling assumed a square, flat area of 1,000 ac was treated with herbicide applied from the air using a fixed-wing aircraft. For suspended particulate matter, modeled impacts were directly proportional to the modeled emission rate. Therefore, the modeling assumed a unit rate of chemical application/deposition (i.e., 1.0 gram per square meter). The model results can be scaled directly to accommodate varying application rates to bare, undisturbed soil. The modeling results were expressed as the fractional downwind deposition based on this initial application.

Determination of Wind Erosion Event

The CALPUFF model was used to estimate acute exposures. The maximum 1-hour and 24-hour, as well as annual average, deposition rates from a conservative impact migration event (i.e., an event modeled using very conservative properties such that the potential for dust migration is high) were computed for the distance ranges being modeled (1.5 to 100 km). Although a given area would be sprayed with herbicide only once per year, a full year was modeled to consider a large range of meteorological conditions that could influence the herbicide migration potential for a single event. The highest impact was considered to represent a "reasonable, but conservative" impact under the range of the meteorological conditions tested. For this modeling, there was no initial restriction on the timing of the herbicide application except as noted below.

The herbicide was assumed to adhere to undisturbed surface soil, which can be picked up and transported by sufficiently high winds. The threshold wind speed for such an event is linked to the "friction velocity", which is a measure of the mechanical turbulence at the soil-atmosphere interface, and thus is a good gauge of the ability of the wind to pick up surface particles. Friction velocity increases with increasing wind speed and increasing surface roughness. Threshold friction velocities for undisturbed soils were determined from Gillette (1988), as described in the Air Quality *Modeling for BLM Vegetation Treatment Methods* report (ENSR 2005k). The BLM (Ypsilantis 2003) identified appropriate soil types for each of the "example" modeling analysis locations, as discussed in more detail in the air quality modeling report.

The CALPUFF modeling procedures assumed that, for each modeled hour of the entire year, the friction velocity exceeded the threshold friction velocity for undisturbed soil. A portion of the herbicide spray mass from the 1,000-acre area therefore became airborne, subject to additional conditions listed below. This assumption is conservative because it also assumes that all of the chemical herbicide would be present in the soil at the commencement of a windy event, and that no reduction due to vegetation interception/up-take, leaching, solar or chemical half-life would have occurred since the time of aerial application. However, the use of a full year of meteorology provides a robust procedure to assess the maximum meteorological condition (i.e., the weather most likely to cause dust migration) for short-term impacts.

In addition to the threshold friction velocity requirement for hourly fugitive emissions of windblown soil, other triggering conditions were considered:

- Wet soil adjustment - assumed no hourly particulate matter emissions when there was measurable hourly precipitation (at least 0.01 in).
- Frozen soil adjustment - assumed no hourly particulate matter emissions when the hourly ambient temperature was at/below 28 degrees Fahrenheit
- Snow cover adjustment - assumed no hourly particulate matter emissions when the hourly snow depth was at least 1 inch.
- Operational adjustment - assumed only one application of chemical herbicide per given 1,000 ac location in the same year.

For these conditions, the surface soil is resistant to movement because it is wet, frozen, and/or covered with an insulating layer of snow. It was assumed that there would be no spraying on a snow-covered surface, although a layer of snow could appear after a spraying event.

Determination of Herbicide Emission Rates

The initial incorporation depth of herbicide (1 mm) determines the concentration of herbicide on eroded dust and defines the depth of erosion at which the mass of herbicide would be exhausted. This mixed depth is based on fast-acting physical processes and does not include leaching of herbicide into the soil due to precipitation.

The mixed layer depth is estimated to account for three processes:

- Physical infiltration of the herbicide into the soil. This is likely a minor factor as little herbicide volume is available to drive infiltration.
- Settling of the herbicide at different depths relative to a given elevation due to uneven soil surface.
- Preferential erosion of fine-grained soils by the wind resulting in segregation of soil particles and mixing of the surface layer.

It was also assumed that there is an even distribution of the herbicide across the soils and that the mass of the herbicide is negligible compared to the mass of the soil. Given a typical soil density of 1 g/cm^3, the mass of a 1-mm depth of soil occupying a square meter is 1,000 grams (g). This represents the total mass of soil per square meter that has to be removed by the wind before all of the herbicide is re-suspended. Using the meteorological data for each site, the mass of soil removed by the wind was calculated for every hour that herbicide re-suspension is possible. The fraction of the herbicide applied to the area that could be released was determined by dividing the mass of soil removed per square meter by 1,000 g (per square meter) for each hour. This percentage was applied at each herbicide's maximum application rate. The resulting value represented the amount of herbicide

potentially released each hour, which was assigned to each of the three particle sizes ($PM_{2.5}$, PM_{10}, and TSP) to estimate potential herbicide deposition.

Calculation of Herbicide Deposition

The deposition algorithm in CALPUFF simulated the effective mass distribution of the adsorbed herbicide, based on particulate matter size (small particles have a larger surface area relative to their mass and, therefore, will carry the majority of the herbicide mass). Dispersion modeling estimated the maximum 1-day and 30-day deposition values at each receptor distance. The results were scaled for typical and maximum application rates.

Watersheds Evaluated

Three watersheds were used in the simulation:

- Glasgow International Airport, Glasgow, Montana
- Medford/Jackson County Airport, Medford, Oregon
- Lander/Hunt Field, Lander, Wyoming

These locations were selected as representative of various regions of the western states addressed by the PEIS. For each location, 1 year of surface meteorological data from the Solar and Meteorological Surface Observation Network (SAMSON) data set that has been produced by National Climatic Data Center (NCDC) was used. After a review of available data capture, the most recent SAMSON year with complete surface and mixing height data was selected for each station. The SAMSON data set is particularly applicable for CALPUFF modeling because it contains hourly values of relative humidity and solar radiation, which are needed for chemical transformation calculations. Mixing height data for these sites were obtained from the USEPA's Technology Transfer Network Support Center for Regulatory Air Models.[2] The highest impact was considered to represent a reasonable, but conservative impact under the range of meteorological conditions tested.

Further details about the CALPUFF model inputs and assumptions can be found in the air quality modeling report (ENSR 2005k).

[2] http://www.epa.gov/ttn/scram/

Accidental Spill

Two spill scenarios were modeled to represent worst-case potential impacts to the pond. The scenarios included a truck or a helicopter spilling entire loads (200 gallon [gal] spill and 140 gal spill, respectively) of herbicide mixed for the maximum application rate into the ¼ ac, 1 m deep pond. To represent an acute exposure event for the three types of aquatic receptors, the pond concentration was compared against the appropriate toxicity endpoint for the fish, aquatic invertebrates, and non-target aquatic plants.

The concentration of herbicide in the pond water is based on the concentration in the spilled solution, the volume spilled, and the volume of the pond, assuming instantaneous mixing.

Non-target Species Effects Characterization

This section summarizes the toxicity of the 10 herbicides to terrestrial and aquatic species found on public lands. There are eight terrestrial herbicide a.i./formulations (bromacil, chlorsulfuron, diflufenzopyr, diuron, imazapic, Overdrive®, sulfometuron methyl, and tebuthiuron) and two aquatic herbicide a.i. (diquat and fluridone). The effects these herbicide a.i. have on non-target species were evaluated for different categories of plants and animals (via surrogate species). The categories of terrestrial species evaluated include terrestrial plants, mammals, birds, reptiles, amphibians, and insects; the categories of aquatic species evaluated include aquatic plants, fish, aquatic invertebrates, and amphibians (in aquatic life stages).

This effects characterization section identifies the TRVs selected from detailed laboratory and field toxicity studies evaluating the acute and chronic impacts of proposed herbicide usage on non-target plants and animals. TRVs were chosen as the lowest reported value for a given type of herbicide exposure (e.g., acute dermal exposure). For a given surrogate species, if an herbicide toxicity level exceeds the chosen TRV, that species and those it represents are at risk of experiencing adverse effects as a result of herbicide application.

Terrestrial Species Effects Characterization

The TRVs representing the effects of each of the 10 herbicides on terrestrial species are presented below and are summarized by receptor type in Tables C-5 to C-15.

Bromacil

Bromacil poses a low toxicity hazard to terrestrial animals (mammals, birds, and honeybees [USEPA 1996]). However, terrestrial plants are sensitive to bromacil, with concentrations as low as 0.0023 pounds (lb) a.i./ac affecting the growth of non-target plants (about 0.06% of the typical application rate).

Mammals

Based on USEPA re-registration documents (USEPA 1996), bromacil is considered to pose a low to moderate acute oral and dermal toxicity hazard to mammals. The oral LD_{50} (641 milligram [mg] a.i./kilogram [kg] BW) and chronic dietary NOAEL (13.3 mg a.i./kg BW-day) were selected as the dietary small mammal TRVs. The dermal small mammal TRV was established at >5,000 mg a.i./kg BW. Because no large mammal LD_{50}s were identified in the available literature, the small mammal LD_{50} was used as a surrogate value. The large mammal dietary NOAEL TRV was established at 4.65 mg a.i./kg BW-day.

Birds

Data from the available literature indicate that bromacil has low toxicity to birds. The bobwhite quail dietary LD_{50} (>30,195 mg/kg BW) and chronic NOAEL (936 mg/kg BW-day) were selected as the small bird dietary TRVs. The mallard dietary LD_{50} (>5,000 mg/kg BW) and NOAEL (155 mg/kg BW-day) were selected as the large bird dietary TRVs.

Terrestrial Invertebrates

Bromacil poses practically no toxicity risk to invertebrates. The honeybee dermal LD_{50} TRV was set at 193 microgram (μg)/bee. Based on a honeybee weight of 0.093 g, this TRV was expressed as 2,075 mg/kg BW.

Terrestrial Plants

Terrestrial plants are at high risk from exposure to bromacil. The lowest and highest germination-based NOAELs were selected to evaluate risk to terrestrial plants in surface runoff scenarios. Emergence endpoints were used when germination data were unavailable. These TRVs were 0.0117 and 0.188 lb a.i./ac. Two additional endpoints were used to evaluate other plant scenarios. These included an EC_{25} of 0.0023 lb a.i./ac and a NOAEL of 0.008 lb a.i./ac (extrapolated from the EC_{25} by dividing by an uncertainty factor of 3).

Chlorsulfuron

Chlorsulfuron poses little to no acute toxicity hazard to mammals via dermal and oral exposure. Adverse effects to small mammals have been documented from long-term dietary exposure to chlorsulfuron. Chlorsulfuron also has low toxicity to birds and slight toxicity to honeybees.

Adverse effects to non-target terrestrial plants occurred at concentrations as low as 0.047 lbs a.i./ac.

Mammals

Based on USEPA re-registration documents (USEPA 2002), chlorsulfuron is characterized as not acutely toxic to mammals via dermal and oral exposure routes. The oral LD_{50} (1,363 mg a.i./kg BW) and chronic dietary NOAEL (5 mg a.i./kg BW-day) were selected as the dietary small mammal TRVs. The dermal small mammal TRV was established at >3,400 mg a.i./kg BW. Because no large mammal LD_{50}s were identified in the available literature, the small mammal LD_{50} was used as a surrogate value. The large mammal dietary NOAEL TRV was established at 65.6 mg a.i./kg BW-day.

Birds

Data from the available literature indicate that chlorsulfuron has low toxicity to birds. The bobwhite quail dietary LD_{50} (>16,970 mg/kg BW) and chronic NOAEL (100 mg/kg BW-day) were selected as the small bird dietary TRVs. The mallard dietary LD_{50} (>1,500 mg/kg BW) and NOAEL (99 mg/kg BW-day) were selected as the large bird dietary TRVs.

Terrestrial Invertebrates

Chlorsulfuron poses a slight toxicity risk to invertebrates. The honeybee dermal LD_{50} TRV was set at >25 μg/bee. Based on a honeybee weight of 0.093 g, this TRV was expressed as 269 mg/kg BW.

Terrestrial Plants

Chlorsulfuron is very highly toxic to plants. The lowest and highest germination-based NOAELs were selected to evaluate risk in surface runoff scenarios. These TRVs were 0.0157 and 0.0052 lb a.i./ac, based on the unverified dyer's woad germination study (EC_{100} divided by uncertainty factors of 3 and 9, respectively). Two additional endpoints were used to evaluate other plant scenarios. These included a life-cycle NOAEL of 0.000021 lb a.i./ac and an EC_{25} of 0.000063 lb a.i./ac (extrapolated from the NOAEL by multiplying by an uncertainty factor of 3).

Diflufenzopyr

As defined by the USEPA, diflufenzopyr alone poses little to no acute toxicity hazard to mammals via dermal and oral exposure. Adverse effects to small mammals have been documented from long-term dietary exposure to technical grade diflufenzopyr. Diflufenzopyr is practically non-toxic to birds and causes slight toxicity to honeybees. However, adverse effects to non-target terrestrial plant species have occurred at concentrations as low as 0.0008 lbs. a.i./ac, which is approximately 1/100 of the typical application rate.

Mammals

Based on USEPA conditional registration documents (USEPA 1999), diflufenzopyr is characterized as having low toxicity to small mammals. The oral LD_{50} (3,300 mg/kg BW) and chronic dietary NOAEL (42.2 mg/kg BW-day) were selected as the dietary small mammal TRVs. The dermal small mammal TRV was established at >5,000 mg/kg BW. Since no large mammal LD_{50}s were identified in the available literature, the small mammal LD_{50} was used as a surrogate value. The large mammal dietary NOAEL TRV was established at 59 mg/kg BW-day.

Birds

Data from the available literature indicate that diflufenzopyr has low toxicity to birds. The small bird chronic dietary NOAEL was set at 634 mg/kg BW-day. Since an acute adverse effect level was not established in the literature, the NOAEL was multiplied by an uncertainty factor of 3, resulting in a small bird dietary LD_{50} of 16,970 mg/kg BW. Similarly, the large bird dietary NOAEL TRV was set at 105 mg/kg BW-day, and using an uncertainty factor of 3, the LD_{50} was estimated to be >2,810 mg/kg BW.

Terrestrial Invertebrates

A honeybee dermal toxicity test suggests that diflufenzopyr has low toxicity to terrestrial invertebrates. Because a suitable LD_{50} could not be determined from the literature, the NOAEL was multiplied by an uncertainty factor of 3. The resulting honeybee dermal LD_{50} TRV was calculated to be 75 μg/bee. Based on a honeybee weight of 0.093 g, this TRV was expressed as 806 mg/kg BW.

Terrestrial Plants

Terrestrial plants appear to be at high risk of toxic effects from application of diflufenzopyr. The lowest and highest germination-based NOAELs were selected to evaluate risk in surface runoff scenarios of the risk assessment (TRVs = 0.028 and 0.0001 lb a.i./ac). Emergence endpoints were used when germination data was unavailable. Two additional endpoints were used to evaluate other plant scenarios: an EC_{25} of 0.0008 lb a.i./ac and a NOAEL of 0.0003 lb a.i./ac (extrapolated from the EC_{25} by dividing by an uncertainty factor of 3).

Diquat

Diquat is moderately toxic to mammals, particularly via dermal exposure. Diquat is also moderately toxic to birds and honeybees. In addition, adverse effects to non-target terrestrial plant species occurred with exposure to low concentrations of diquat (0.0046 lbs a.i./acre; 0.5% of the typical application rate).

Mammals

According to USEPA re-registration eligibility documents (USEPA 1995b), diquat is considered to be moderately toxic to mammals. Based on these findings, the oral LD_{50} (121 mg/kg BW) and chronic dietary NOAEL (0.8 mg a.i./kg BW-day) were selected as the dietary small mammal TRVs. The dermal small mammal TRV was established at 262 mg a.i./kg BW. Since no large mammal LD_{50}s were identified in the available literature, the small mammal LD_{50} was used as a surrogate value. The large mammal dietary NOAEL TRV was established at 0.5 mg a.i./kg BW-day.

Birds

Data from the literature indicate that diquat has moderate toxicity to birds. The bobwhite quail dietary LD_{50} (150 mg a.i./kg BW) and chronic NOAEL (12

mg a.i./kg BW-day) were selected as the small bird dietary TRVs. The pheasant dietary LD_{50} (215 mg a.i./kg BW) and the mallard dietary chronic NOAEL (0.6 mg a.i./kg BW-day) were selected as the large bird dietary TRVs.

Terrestrial Invertebrates

A dermal toxicity study in honeybees suggests that diquat has low toxicity to terrestrial invertebrates. The honeybee dermal TRV was set at 47 μg/bee, the 5-day LD_{50} value. Based on a honeybee weight of 0.093 g, this TRV was expressed as 505 mg/kg BW.

Terrestrial Plants

Terrestrial plants appear to be at high risk of toxic effects from exposure to diquat. Two endpoints were used to evaluate terrestrial plant scenarios for aquatic herbicides. These included an EC_{25} and a NOAEL. Since the lowest EC_{25} identified in the database (0.047 lb a.i./ac) was lower than the lowest reported NOAEL, the terrestrial plant NOAEL TRV (0.0016 lb a.i./ac) was calculated by dividing the EC_{25} value by an uncertainty factor of 3.

Diuron

Diuron is not considered to be highly toxic to most terrestrial species. In mammals, diuron is considered to have low acute oral and dermal toxicity. However, adverse effects have been demonstrated in mammals from long-term exposure to diuron in the diet. Diuron is slightly toxic to birds but essentially non-toxic to honeybees. Significant adverse effects were noted in non-target terrestrial plant species after 14 days exposure to concentrations as low as 0.08 lb a.i./ac.

Mammals

Because fairly large single doses of diuron are required before adverse effects are noted, diuron is considered to have low acute toxicity to mammals, but diuron does have moderate chronic toxicity to mammals. The oral LD_{50} (1,017 mg a.i./kg BW) and chronic dietary NOAEL (2.5 mg a.i./kg BW-day) were selected as the dietary small mammal TRVs. The dermal small mammal TRV was established at >2,500 mg a.i./kg BW. Since no large mammal LD_{50}s were identified in the available literature, the small mammal acute LD_{50} (1,017 mg a.i./kg BW-day) was used as a surrogate value. The large mammal dietary chronic NOAEL TRV was established at 0.6 mg a.i./kg BW-day.

Birds

Data from available literature indicate that diuron has low toxicity to birds (toxicity is higher for large birds than small birds). The bobwhite quail dietary LD_{50} (5,225 mg/kg BW-day) and the mallard dietary LD_{50} (865 mg/kg BW-day) were selected as the small and large bird dietary TRVs. Since NOAEL values for small and large birds were unavailable, the LD_{50}s were divided by an uncertainty factor of 3 to derive NOAEL TRVs of 348 and 58 mg/kg BW-day for small and large birds, respectively.

Terrestrial Invertebrates

A dermal toxicity study in honeybees suggests that diuron has low toxicity to terrestrial invertebrates. The honeybee dermal LD_{50} TRV was set at 145.03 μg/bee. Based on a honeybee weight of 0.093 g, this TRV was expressed as 1,560 mg/kg BW.

Terrestrial Plants

Terrestrial plants appear to be at high risk of toxic effects from diuron application. The lowest and highest germination-based NOAELs were selected to evaluate risk in surface runoff scenarios. However, because germination data were not available for diuron, the emergence TRVs of 0.047 and 12 lb a.i./ac were selected instead. Two additional endpoints were used to evaluate other plant scenarios. These included a seed emergence EC_{25} of 0.08 lb a.i./ac and a vegetative vigor NOAEL of 0.001 lb a.i./ac.

Fluridone

Fluridone has low toxicity to most terrestrial animals. Studies conducted with mammals found that acute exposure to fluridone usually does not cause adverse effects, even to mammals that were exposed to fluridone for longer periods of time or during pregnancy. Similarly, short-term exposure to fluridone did not result in adverse effects in birds, even at high exposure levels. Long-term exposure to fluridone did result in reduced growth in large and small birds. Fluridone was practically non-toxic to honeybees. While no quantitative data were found to evaluate fluridone's effects on terrestrial plants, the manufacturer's user guide (Eli Lilly and Company 2003) provided qualitative results indicating that the sensitivity of terrestrial plants is variable. Some species (e.g., grasses and sedges) were more sensitive than other plant species (e.g., willow).

Mammals

Fluridone poses little acute risk to small mammals. The oral LD_{50} (>10,000 mg a.i./kg BW) and chronic dietary NOAEL (8 mg a.i./kg BW-day) were selected as the dietary small mammal TRVs. The dermal small mammal TRV was established at >5,000 mg a.i./kg BW. Since no large mammal LD_{50}s were identified in the available literature, the small mammal LD_{50} (>10,000 mg a.i./kg BW) was used as a surrogate value. The large mammal dietary NOAEL TRV was established at 75 mg a.i./kg BW-day. Overall, acute exposure to fluridone causes few adverse effects to mammals, but adverse effects can occur if mammals are chronically exposed to fluridone. Small mammals may be slightly more susceptible to fluridone than large mammals.

Birds

Information related to avian exposure to fluridone suggests that acute oral exposure to fluridone is practically non-toxic to birds. The bobwhite quail dietary LD_{50} (>13,135 mg/kg BW) and chronic NOAEL (604 mg a.i./kg BW-day) were selected as the small bird dietary TRVs. The mallard dietary LD_{50} (>2,270 mg/kg BW) and NOAEL (100 mg a.i./kg BW-day) were selected as the large bird dietary TRVs.

Terrestrial Invertebrates

Honeybee dermal toxicity studies indicate that fluridone has low toxicity to terrestrial invertebrates. Because an LD_{50} was not established in the literature, the NOAEL was multiplied by an uncertainty factor of 3, resulting in an LD_{50} of 1,088 μg/bee. Based on a honeybee weight of 0.093 g, this TRV was expressed as 11,699 mg a.i./kg BW.

Terrestrial Plants

No quantitative toxicity studies were found in the reviewed literature that addressed toxicity of fluridone to terrestrial plants. In the manufacturer's user's guide (Eli Lilly and Company 2003), grasses and some sedges are considered to be "sensitive" or "intermediate" in their tolerance to the Sonar herbicide, while rushes tend to be "intermediate" to "tolerant." Shoreline plants, such as willow and cypress, were considered "tolerant," while the tolerance of members of the evening primrose and acanthus families was classified as "intermediate."

Imazapic

The information identified during the literature review indicates that imazapic is not highly toxic to most terrestrial animal species, although it is fairly toxic to non-target terrestrial plant species. Since the herbicide is rapidly metabolized and excreted in urine and feces, imazapic does not bioaccumulate in animals. In mammals, pesticide registration studies found that exposure to imazapic does not frequently cause adverse effects, even at relatively high dose levels. Nevertheless, mammals may be more susceptible during pregnancy, and large mammals may be slightly more sensitive to imazapic than small mammals. During short-term acute exposures, imazapic did not cause adverse effects in birds; however, long-term exposure to imazapic did result in reduced growth in large and small birds. For terrestrial plants, significant adverse effects were noted in non-target plant species after 14 days exposure to concentrations as low as 0.01 lb a.i./ac (approximately 1/3 of the typical application rate).

Mammals

Included in the registration reports were acute oral toxicity studies conducted in rats that demonstrated that exposure to imazapic typically does not cause adverse effects, even at relatively high dose levels (e.g., >5,000 mg a.i./kg BW; SERA 2001). Based on these findings, the oral LD_{50} (>5,000 mg a.i./kg BW) and chronic dietary NOAEL (1,728 mg/kg BW-day) were selected as the dietary small mammal TRVs. The dermal small mammal TRV (LD_{50}) was established at >2,000 mg/kg BW. Because a NOAEL was not identified in the available literature, it was calculated by dividing the LOAEL (137 mg/kg BW-day) by an uncertainty factor of 3, resulting in a large mammal dietary NOAEL TRV of 46 mg/kg BW-day. Overall, exposure to imazapic causes few adverse effects to mammals under most circumstances, even at high concentrations. However, large mammals may be more susceptible to imazapic than small mammals, and mammals may be more susceptible to imazapic during pregnancy.

Birds

Based on available data, imazapic appears to have low toxicity to birds. No adverse effects were observed in bobwhite quail administered imazapic at dose levels as high as 2,150 mg/kg BW for 21 days (USEPA 2003). The bobwhite quail dietary LD_{50} (>15,095 mg/kg BW) and chronic NOAEL (113 mg/kg BW-day) were

selected as the small bird dietary TRVs. The mallard dietary LD_{50} (>2,500 mg/kg BW) and NOAEL (65 mg/kg BW-day) were selected as the large bird dietary TRVs.

Terrestrial Invertebrates

A dermal toxicity study in honeybees suggested that imazapic poses low toxicity hazard to terrestrial invertebrates. The honeybee dermal LD_{50} TRV was set at >100 µg/bee. Based on a honeybee weight of 0.093 g, this TRV was expressed as 1,075 mg/kg BW.

Terrestrial Plants

Imazapic appears to be highly toxic to terrestrial plants. The lowest and highest germination-based NOAELs were selected to evaluate risk in surface runoff scenarios. These TRVs were 0.064 and 0.032 lb a.i./acre. Two additional endpoints were used to evaluate other plant scenarios. These included an EC_{25} of 0.01 lb a.i./acre and an NOAEL of 0.008 lb a.i./acre.

Overdrive®

Overdrive® is a formulation containing dicamba and diflufenzopyr. Because Overdrive® is a recently approved herbicide; no Overdrive® toxicity data were identified. However, the herbicide Distinct® contains the same ratio of dicamba and diflufenzopyr, and several Distinct® studies were identified in the literature review. Therefore, Distinct®, dicamba, and diflufenzopyr toxicity data were examined to evaluate the toxicity of Overdrive® to receptor species.

Diflufenzopyr poses little to no acute toxicity hazard to mammals via dermal and oral exposure, Distinct® herbicide poses a slight toxicity hazard to mammals, and dicamba is considered to be slightly toxic to mammals via dermal and oral exposures. Adverse effects to small mammals have been documented from long-term dietary exposure to technical grade diflufenzopyr. Long term exposures to dicamba did not show significant mortality, reproductive, or teratogenic effects at the tested levels (up to 25 mg/kg/day).

Diflufenzopyr and dicamba are considered practically non-toxic to birds. Diflufenzopyr causes slight toxicity to honeybees, but dicamba is considered non-toxic to honeybees. For terrestrial plants, adverse effects to non-target species occurred at diflufenzopyr concentrations as low as 0.0008 lbs. a.i./acre, at dicamba concentrations as low as 0.00027 lb a.i./ac, and at Distinct® concentrations as low as 0.0043 lb a.i./ac.

Diflufenzopyr is moderately toxic to fish and aquatic invertebrates, while dicamba has only low toxicity to aquatic organisms. Diflufenzopyr was toxic to aquatic macrophytes, specifically duckweed, with Distinct® being more toxic and dicamba being less toxic.

Mammals

Diflufenzopyr poses little to no acute toxicity hazard to mammals via dermal and oral exposure, but may pose chronic risk. Distinct® and dicamba pose slight toxicity hazards to mammals via dermal and oral exposures. The dermal small mammal TRVs were established at >5,000 mg/kg BW for diflufenzopyr and Distinct®, and >5,050 mg/kg BW for dicamba. The dietary small mammal diflufenzopyr TRV based on the oral LD_{50} was 3,300 mg/kg BW for diflufenzopyr. The dietary small mammal TRV based on the oral LD_{50} was 566 mg/kg BW for dicamba. The dietary small mammal TRV based on the oral LD_{50} was 1,600 mg/kg BW for Distinct®.

Based on the NOAEL, the chronic dietary small mammal TRV was established at 42.2 mg/kg BW-day for diflufenzopyr and at 3 mg/kg BW-day for dicamba. No small mammal chronic studies were reported for Distinct® or Overdrive®, and therefore, no TRV could be developed.

Because no large mammal LD_{50}s for diflufenzopyr, dicamba, or Distinct® were identified in the available literature, the small mammal LD_{50} was used as surrogate values. In addition, no large mammal chronic toxicity data were identified for Distinct® or Overdrive®, and consequently no TRV could be developed. Based on the available data, the large mammal dietary NOAEL TRV for diflufenzopyr was established at 59 mg/kg BW-day, and the chronic large mammal dietary TRV was established at 0.15 mg/kg BW-day for dicamba.

Birds

Data from the available literature indicate that diflufenzopyr has low toxicity to birds. The diflufenzopyr acute small bird dietary LD_{50} TRV was set at >16,970 mg/kg BW based on the bobwhite quail, and the acute large bird dietary LD_{50} TRV was set at >2,810 mg/kg BW. The diflufenzopyr chronic small bird dietary NOAEL was set at 634 mg/kg BW-day, based on the bobwhite quail, and the large bird

NOAEL was set at 105 mg/kg BW-day, based on the mallard.

Dicamba is classified as practically non-toxic to birds. The dicamba acute small bird dietary LD_{50} was set at >30,190 mg/kg BW, based on the bobwhite quail, and the large bird LD_{50} was set at >5,000 mg/kg BW, based on the mallard. The dicamba chronic small bird dietary NOAEL was set at 170 mg/kg BW-day, based on the bobwhite quail, and the large bird NOAEL was set at 92 mg/kg BW-day, based on the mallard.

Only one acute study was identified for Distinct®. The Distinct® acute small bird dietary LD_{50} was set at >18,360 mg/kg BW, based on the bobwhite quail. Because no chronic data were available, the 8-day NOAEL, 3,672 mg/kg BW-day, was used as the small bird NOAEL TRV. Due to a lack of additional data, no large bird TRVs were derived.

Terrestrial Invertebrates

Diflufenzopyr and dicamba appear to be practically non-toxic to terrestrial invertebrates, as represented by the honeybee. The honeybee dermal LD_{50} for diflufenzopyr was calculated to be 806 mg/kg BW. For dicamba, the LD_{50} value was calculated as 974 mg/kg BW. No honeybee data were identified for Distinct®.

Terrestrial Plants

Because germination data were unavailable, the lowest and highest emergence-based NOAELs were selected to evaluate risk in surface runoff scenarios of the risk assessment. The diflufenzopyr TRVs were 0.0001 and 0.028 lb a.i./acre. Two additional endpoints were used to evaluate other plant scenarios. These included an EC_{25} of 0.0008 lb a.i./acre and a NOAEL of 0.0003 lb a.i./acre.

The dicamba TRVs were <0.0022 and 0.53 lb a.i./ac. To evaluate other plant scenarios, two additional endpoints were used. These included the lowest dicamba EC_{25} of 0.00027 lb a.i./ac and the highest NOAEL that was still below the selected $EC_{2.5}$. The only NOAEL that met this criteria was the <0.0022 lb a.i./ac germination value.

The Distinct® TRVs were 0.0016 and 0.046 lb a.i./ac. To evaluate other plant scenarios, two additional endpoints were used. These included the lowest Distinct® EC_{25} of 0.0043 lb a.i./ac and the highest NOAEL that was still below the selected EC_{25} of 0.004 lb a.i./ac for vegetative vigor in tomatoes (USEPA 2003; Master Record Identifier (MRID) number 45047301).

Sulfometuron Methyl

Sulfometuron methyl has low toxicity to most terrestrial species. In mammals, sulfometuron methyl is considered to have low acute oral and dermal toxicity. However, adverse effects were demonstrated in mammals from long-term exposure to sulfometuron methyl in the diet or via oral gavage during pregnancy. Sulfometuron methyl is essentially non-toxic to birds and honeybees. There appears to be little difference in the high sensitivities of weeds and non-target plants to sulfometuron methyl, though the response of weed species to sulfometuron methyl may be more severe than for crop species. Pine species are less sensitive than broadleaves or grasses. Rare, Threatened and Endangered species do appear to be particularly sensitive to sulfometuron methyl.

Mammals

Sulfometuron methyl is considered to have low acute toxicity to mammals, but moderate chronic toxicity. The oral LD_{50} (>5,000 mg a.i./kg BW) and the chronic dietary NOAEL (18 mg a.i./kg BW-day) were selected as the dietary small mammal TRVs. The dermal small mammal TRV was established at >8,000 mg a.i./kg BW. Because no large mammal LD_{50}s were identified in the available literature, the small mammal LD_{50} was used as a surrogate value, and the large mammal chronic dietary NOAEL TRV was established at 28 mg a.i./kg BW-day.

Birds

In the studies evaluated, no adverse effects have been demonstrated in birds exposed to sulfometuron methyl. The bobwhite quail dietary LD_{50} (>16,970 mg a.i./kg BW-day) and extrapolated NOAEL (1,131 mg a.i./kg BW-day) were selected as the small bird dietary TRVs. The mallard dietary LD_{50} (>2,300 mg a.i./kg BW-day) and extrapolated NOAEL (153 mg a.i./kg BW-day) were selected as the large bird dietary TRVs.

Terrestrial Invertebrates

A honeybee dermal toxicity study suggests that sulfometuron methyl is of low toxicity to terrestrial invertebrates. The honeybee dermal LD_{50} TRV was set at 300 μg/bee (extrapolated from the NOAEL). Based on a honeybee weight of 0.093 g, this TRV was expressed as 3,226 mg/kg BW.

Terrestrial Plants

Sulfometuron methyl appears to be highly toxic to terrestrial plants. The lowest and highest germination-based NOAELs were selected to evaluate risk in surface runoff scenarios of the risk assessment. These terrestrial plant TRVs were established as 0.000028 and 1.12 lb a.i./ac, based on emergence data. Two additional endpoints were used to evaluate other plant scenarios; these included an EC_{25} of 0.22 lb a.i./ac BW and a NOAEL of 0.000028 lb a.i./ac.

Tebuthiuron

Tebuthiuron has moderate toxicity to most terrestrial species. In mammals, tebuthiuron is considered to have low acute dermal toxicity, but adverse effects can occur when organisms are exposed for greater periods of time (e.g., via diet or oral gavage). Tebuthiuron is essentially non-toxic to birds and slightly toxic to honeybees. Tests conducted on crop plant species found adverse effects at concentrations as low as 0.03 lbs a.i./ac (6% of the typical application rate).

Mammals

Tebuthiuron is considered to have moderate toxicity to mammals. The oral LD_{50} (58 mg a.i./kg BW) and chronic dietary NOAEL (7 mg a.i./kg BW-day) were selected as the dietary small mammal TRVs. The dermal small mammal TRV was established at >5,000 mg a.i./kg BW. The large mammal dietary LD_{50} was established at >500 mg a.i./kg BW-day, and the NOAEL TRV was established at 12.5 mg a.i./kg BW-day.

Birds

In the studies evaluated, no adverse effects were reported in birds exposed to tebuthiuron. The small bird dietary LD_{50} was established at >15,440 mg a.i./kg BW, based on the bobwhite quail study. A small bird dietary NOAEL value was calculated by dividing the daily dose by an uncertainty factor of 3. The resulting NOAEL was 1,029 mg a.i./kg BW-day. The large bird dietary LD_{50} was established at >2,545 mg a.i./kg BW-day, based on the mallard duck. The large bird NOAEL was established at 1,000 mg a.i./kg BW-day, based on hens.

Terrestrial Invertebrates

Based on a honeybee dermal toxicity study, tebuthiuron appears to have low toxicity to terrestrial invertebrates. The honeybee dermal LD_{50} TRV was set at 30 μg a.i./bee. Based on a honeybee weight of 0.093 g, this TRV was expressed as 323 mg a.i./kg BW.

Terrestrial Plants

Available data suggests that tebuthiuron has high toxicity to terrestrial plants. The NOAEL TRVs were established at >6 and 0.01 lb a.i./ac (extrapolated from the EC_{25} of 0.03 lb a.i./ac), based on germination and emergence data, respectively. Two additional endpoints were used to evaluate other plant scenarios.

Aquatic Species Effects Characterization

This aquatic effects characterization section summarizes the acute and chronic toxicity study results demonstrating the impacts of proposed herbicide usage on non-target aquatic plants, aquatic invertebrates, fish, and aquatic life stages of amphibians.

The acute toxicity levels of the herbicides are classified according to the observed LC_{50} values:

- less than 0.1 mg/L – very highly toxic
- 0.1 to 1 mg /L – highly toxic
- 1 to 10 mg/L – moderately toxic
- 10 to 100 mg/L – slightly toxic
- greater than 100 mg/L – practically non-toxic

Bromacil

Bromacil is slightly toxic to effectively non-toxic to most aquatic animals. For fish, acute toxic effects of bromacil occurred at concentrations of 36 mg/L, and coldwater fish species appear to be slightly more sensitive to bromacil than warmwater species. Also, bromacil does not tend to bioconcentrate appreciably in fish tissue. Compared to fish, aquatic invertebrates are less sensitive to acute bromacil exposures, with acute adverse effect concentrations occurring at 65 mg a.i./L. In contrast, growth of the green algae, *Selenastrum capricornutum*, was adversely impacted by bromacil concentrations as low as 0.0068 mg/L. No acceptable toxicity studies were found for amphibians.

Fish

Bromacil is slightly toxic to fish. The coldwater 96-hour LC_{50} of 36 mg/L was selected as the acute TRV (the lower of the cold- and warmwater fish endpoints were selected as the TRVs for fish), and the warmwater fish NOAEL of 0.33 mg /L was used as the TRV for chronic effects.

Amphibians

Bromacil is slightly toxic to amphibians. The LC_{50} (230 mg/L) was selected as an amphibian acute TRV. The NOAEL was extrapolated from the LC_{50} using an uncertainty factor of 3. The resulting NOAEL TRV was 77 mg/L.

Aquatic Invertebrates

Bromacil is also slightly toxic to aquatic invertebrates. The LC_{50} (65 mg a.i./L) was selected as the invertebrate acute TRV. Since no NOAEL value in the reviewed literature was lower than the LC_{50}, the LC_{50} was divided by an uncertainty factor of 3 to estimate a NOAEL TRV of 22 mg a.i./L. It may be noted that the use of this NOAEL TRV to evaluate chronic scenarios is conservative, as it is based on a short-term study, but not a chronic study.

Aquatic Plants

In contrast, bromacil is very highly toxic to aquatic plants. The EC_{50} (0.0068 mg/L) was selected as the aquatic plant acute TRV. Because no NOAEL value in the reviewed literature was lower than the EC_{50}, the EC_{50} was divided by an uncertainty factor of 3 to estimate a NOAEL TRV of 0.0023 mg /L. It may be noted that the use of this NOAEL TRV to evaluate chronic scenarios is conservative, as it is based on a short-term study, but not a chronic study.

Chlorsulfuron

Chlorsulfuron is slightly toxic to fish and aquatic invertebrates. No toxicity studies conducted on amphibian species were found in the literature reviewed. Chlorsulfuron is very highly toxic to aquatic macrophytes. Aquatic macrophytes are adversely affected by concentrations as low as 0.00007 mg/L.

Fish

Chlorsulfuron is slightly toxic to fish. The coldwater 96-hour LC_{50} of 40 mg/L was selected as the acute TRV (the lower of the coldwater and warmwater fish endpoints). The warmwater fish NOAEL (17 mg /L; extrapolated from the LC_{50}) was used as the TRV for chronic effects (coldwater and warmwater fish species may have comparable sensitivity to chlorsulfuron). Chlorsulfuron is not likely to bioconcentrate in fish tissue. It may be noted that the use of this NOAEL TRV to evaluate chronic scenarios is conservative, as it is based on a short-term study, but not a chronic study.

Aquatic Invertebrates

Chlorsulfuron is practically non-toxic to aquatic invertebrates. The LC_{50} (368.9 mg/L) was selected as the invertebrate acute TRV and the 21-day NOAEL (20 mg/L) was selected as the chronic TRV.

Aquatic Plants

Chlorsulfuron is very highly toxic to aquatic plants. The EC_{50} (0.00007 mg a.i./L) was selected as the aquatic plant acute TRV. The highest NOAEL below the acute TRV was the NOAEL from the same study (0.004 mg a.i./L).

Diflufenzopyr

Diflufenzopyr is moderately toxic to fish and aquatic invertebrates. No toxicity studies conducted on amphibian species were found in the literature reviewed. Diflufenzopyr is also toxic to aquatic macrophytes, which are adversely affected by diflufenzopyr and its various formulations at concentrations as low as 0.0078 mg/L. There do not appear to be appreciable differences in sensitivities among aquatic macrophytes, diatoms, and algae.

Fish

Results from coldwater and warmwater fish species suggest that diflufenzopyr has relatively low toxicity to fish species. The lower of the coldwater and warmwater fish endpoints were selected as the TRVs for fish. Therefore, the coldwater 96-hour LC_{50} of 106 mg/L was selected as the acute TRV, and the warmwater fish NOAEL of 16 mg/L was used as the TRV for chronic effects.

Aquatic Invertebrates

Based on toxicity studies in daphnids, diflufenzopyr appears to be slightly to moderately toxic to aquatic invertebrates. The EC_{50} (15 mg/L) and NOAEL (9.7 mg/L) were selected as the invertebrate TRVs.

Aquatic Plants

In studies with duckweed, diflufenzopyr has high toxicity to aquatic plants. In 14-day toxicity tests, 50% of the duckweed plants were adversely affected by concentrations as low as 0.11 mg a.i./L of Distinct herbicide (the EC_{50}) (USEPA 2003). The green algae EC_{50} (0.1 mg/L) and NOAEL (0.0078 mg/L) were selected as the aquatic plant TRVs.

Diquat

Diquat has relatively high toxicity to fish and aquatic invertebrates. Diquat does not appear to appreciably bioconcentrate in fish tissue. No acute toxicity studies conducted on amphibian species were found in the literature. Aquatic macrophytes were adversely affected by diquat concentrations as low as 0.00075 mg/L. There did not appear to be appreciable differences in sensitivities among aquatic macrophytes, diatoms, and algae.

Fish

Results from coldwater and warmwater fish species suggest that diquat has high toxicity to fish species. The lower of the coldwater and warmwater fish endpoints were selected as the TRVs for fish; therefore, the warmwater 96-hour LC_{50} of 0.75 mg a.i./L was selected as the acute TRV. Because the NOAEL in a chronic study on rainbow trout was determined to be <0.5 mg a.i./L, the coldwater fish NOAEL was calculated by dividing this value by an uncertainty factor of 3. The resulting NOAEL TRV for coldwater fish species was 0.17 mg a.i./L; this was selected as the chronic fish TRV. In addition, the bioconcentration potential for diquat is low.

Amphibians

In a chronic toxicity study on northern leopard frogs, diquat was found to have moderate toxicity to amphibians. In a 16-day exposure, frogs were adversely affected by diquat concentrations as low as 5 mg/L, while no adverse effects were observed at 2 mg/L. The NOAEL (2 mg/L) was selected as an amphibian chronic TRV.

Aquatic Invertebrates

Toxicity studies on daphnids and amphipods suggest that diquat is highly toxic to aquatic invertebrates. The LC_{50} (0.14 mg/L) was selected as the invertebrate acute TRV, and the NOAEL of 0.044 mg/L was selected as the chronic TRV.

Aquatic Plants

Duckweed toxicity studies suggest that diquat is very highly toxic to aquatic plants. In 14-day studies, 50% of the duckweed plants were adversely affected by concentrations as low as 0.00075 mg/L of diquat (i.e., the EC_{50}; USEPA 2003; MRID 41883002). The EC_{50} (0.00075 mg/L) was selected as the aquatic plant acute TRV. Because no NOAEL value in the reviewed literature was lower than the EC_{50}, the EC_{50} was divided by an uncertainty factor of 3 to estimate a NOAEL TRV of 0.0003 mg/L.

Diuron

Diuron is moderately toxic to fish and highly toxic to aquatic plants and aquatic invertebrates. Toxicity tests indicate that diuron is toxic to fish species at concentrations as low as 0.71 mg/L. Diuron has a low to moderate potential to bioconcentrate in fish tissue. Amphibians were less sensitive to diuron than any other aquatic taxa. Aquatic invertebrates were affected by diuron concentrations of 0.16 mg a.i./L. Aquatic plants were affected at concentrations as low as 0.0013 mg a.i./L (about 0.02% of the typical application rate).

Fish

Diuron is considered moderately to highly toxic to fish. The lower of the coldwater and warmwater fish endpoints were selected as the TRVs for fish. Therefore the coldwater 96-hour LC_{50} of 0.71 mg/L was selected as the acute TRV, and the warmwater fish NOAEL of 0.033 mg a.i./L was used as the TRV for chronic effects.

Amphibians

Toxicity tests suggest that diuron is slightly toxic to amphibians. Acute toxicity was observed in amphibians exposed to diuron concentrations of 12.7 mg/L. In chronic toxicity tests, adverse effects on growth were observed at concentrations of 14.5 mg/L, with no effects observed at 7.6 mg a.i./L. The LC_{50} (12.7 mg/L) was selected as an amphibian acute TRV, and the NOAEL (7.6 mg/L) was selected as the chronic TRV.

Aquatic Invertebrates

Diuron is considered to have relatively high toxicity to aquatic invertebrates. The LC_{50} (0.16 mg/L) was selected as the invertebrate acute TRV. Since none of the observed chronic NOAEL values were below the selected acute TRV, the chronic LOAEL from a 28-day daphnid assay was divided by an uncertainty factor of 3 to estimate a chronic NOAEL TRV of 0.067 mg a.i./L.

Aquatic Plants

Toxicity tests on green algae (the most sensitive of aquatic plants tested) suggest that diuron is very highly toxic to aquatic plants. The EC_{50} (0.0013 mg/L) was selected as the aquatic plant acute TRV, and the NOAEL (0.00044mg/L) was selected as the chronic TRV.

Fluridone

In the available literature, aquatic plants were affected by concentrations less than 1 mg/L. Acute and chronic toxicity tests indicate that fluridone is toxic to fish species at concentrations less than 10 mg/L, and some adverse effect concentrations approach 1 mg/L. No data were found to evaluate the toxicity of fluridone to amphibians. Acute toxicity concentrations for aquatic invertebrates were as low as 1.3 mg/L, which is equal to the maximum application rate.

Fish

Fluridone is considered to be moderately toxic to fish species. The lower of the coldwater and warmwater fish endpoints were selected as the TRVs for fish. Therefore, the coldwater 96-hour LC_{50} of 4.2 mg a.i./L was selected as the acute TRV, and the warmwater fish NOAEL of 0.48 mg a.i./L was used as the TRV for chronic effects.

Amphibians

No toxicity studies for amphibians were found in the literature reviewed for fluridone.

Aquatic Invertebrates

Fluridone appears to be moderately toxic to aquatic invertebrates. Acute toxicity was observed in aquatic invertebrates exposure to fluridone concentrations as low as 1.3 mg/L. NOAELs for several species were derived from chronic or short-term chronic studies. The NOAEL for *D. magna* is 0.2 mg/L and the NOAELs for *Gammarus pseudolimnaeus* and *Chironomus plumosus* are 0.6 mg/L. The LC_{50} (1.3 mg/L) was selected as the invertebrate acute TRV, and the NOAEL of 0.6 mg/L was selected as the chronic TRV.

Aquatic Plants

Toxicity studies on American pondweed suggest that fluridone is moderately toxic to aquatic plants. No adverse effects to aquatic macrophytes were detected with fluridone concentrations of 1 mg/L, and the NOAEL was set at 1 mg/L. Because no EC_{50} values were identified in the literature, the NOAEL was multiplied by an uncertainty factor of 3 to estimate an EC_{50} of 3 mg/L.

Imazapic

Imazapic is relatively toxic to aquatic plants, but is much less toxic to aquatic animal species. Aquatic plants were affected at concentrations as low as 0.0042 mg/L. Toxicity tests indicate that imazapic has low toxicity to fish species and does not appreciably bioconcentrate in fish tissue. No data were found to evaluate the toxicity of imazapic to amphibians. Most studies reported that aquatic invertebrates were unaffected by imazapic concentrations of 100 mg/L; however, one unverifiable report suggested that chronic toxicity to aquatic invertebrates may occur at concentrations as low as 0.18 mg/L.

Fish

Imazapic is considered to have low toxicity to fish species. The coldwater 96-hour LC_{50} of >100 mg/L (the lower of the coldwater and warmwater fish endpoints) was selected as the acute TRV. The LC_{50} was divided by an uncertainty factor of 3, to produce a coldwater fish NOAEL of 33 mg/L used as the TRV for chronic effects. It may be noted that the selected chronic TRV, extrapolated from an LC_{50} indicating essentially no risk, is 3 times lower than the true chronic NOAEL observed for warmwater fish. This may overestimate chronic risk to fish.

Amphibians

No toxicity studies for amphibians were found in the published literature or in USEPA registration documents.

Aquatic Invertebrates

Imazapic is generally considered to have low toxicity to aquatic invertebrates. The LC_{50} (>100 mg/L) was selected as the invertebrate acute TRV. The 21-day NOAEL (96 mg a.i./L) was selected as the invertebrate chronic TRV.

Aquatic Plants

Toxicity studies on duckweed suggest that imazapic is very highly toxic to aquatic plants. In these studies, 25% of the duckweed plants were adversely affected by concentrations of 0.0042 mg/L after 14 days exposure. The no effect concentration in this study was 0.0026 mg/L. Compared to duckweed, freshwater algae and diatoms were at least 10 times more tolerant of imazapic. In 5-day acute toxicity tests, LC_{50} values for algae and diatoms were greater than the highest concentration tested (at least 0.04 mg/L). The aquatic plant TRVs were set at 0.0042 mg/L (EC_{25}) and 0.0026 mg/L (NOAEL).

Overdrive®

Based on toxicity data from dicamba, diflufenzopyr, and Distinct®, and using the conservative assumption that Overdrive® is slightly more toxic than dicamba and diflufenzopyr, Overdrive® may be considered slightly toxic to fish, moderately toxic to aquatic invertebrates (Distinct® was much less toxic to aquatic invertebrates than dicamba), and highly toxic to aquatic plants. Dicamba is practically non-toxic to amphibians, but no data were available for the other chemicals.

Fish

Toxicity tests suggest that diflufenzopyr is practically non-toxic to fish, and dicamba is slightly toxic to fish. No fish toxicity tests were identified for Distinct®. The selected fish TRVs for diflufenzopyr were established at 106 mg/L (warmwater LC_{50}) and 16 mg/L (coldwater NOAEL). The selected fish TRVs for dicamba were established at 28 mg/L (coldwater LC_{50}) and 9.3 mg/L (estimated coldwater NOAEL). No chronic toxicity studies on freshwater fish were found in the available literature, and therefore all TRVs are based on acute duration endpoints.

The bioconcentration factor for diflufenzopyr is 3.16, indicating that diflufenzopyr would not appreciably bioconcentrate in fish tissue (National Library of Medicine 2002). In contrast, the bioconcentration factor for dicamba range from 8 to 28, indicating that dicamba may bioconcentrate in fish tissue (HSDB 2002).

Amphibians

A single amphibian toxicity study was found during the literature review, and it suggested that dicamba is practically non-toxic to amphibians. The 96-hour toxicity test with dicamba (as the a.i. in Banvel) using tadpoles of two frog species, resulted in LC_{50}s of 106 and 185 mg a.i./L (Johnson 1976). A NOAEL of 35.3 mg a.i./L was estimated by applying an uncertainty factor of 3 to the lowest LC_{50}.

Aquatic Invertebrates

Toxicity tests indicate that diflufenzopyr is slightly toxic, dicamba is moderately toxic, and Distinct® is practically non-toxic to aquatic invertebrates. One diflufenzopyr acute toxicity test using water fleas (e.g., *Daphnia magna*) was found in the literature. The selected invertebrate TRVs for diflufenzopyr were established at 15 mg/L (EC_{50}) and 9.7 mg/L (NOAEL), indicating that diflufenzopyr is slightly toxic to aquatic invertebrates.

Several dicamba aquatic invertebrate tests were identified, resulting in LC_{50}s ranging from 3.8 mg/L for the scud (Hurlbert 1975) to >1,000 mg/L for the water flea (Forbis et al. 1985). The selected dicamba LC_{50} (3.8 mg /L) was divided by an uncertainty factor of 3, to result in a dicamba NOAEL of 1.27 mg/L.

One 48-hour acute Distinct® water flea test was identified. No effects were observed at the highest tested concentration, 130 mg a.i./L (USEPA 2003; MRID 45310903). The NOAEL (130 mg/L) was multiplied by an uncertainty factor of 3, to result in a Distinct® EC_{50} of 390 mg/L.

No chronic toxicity studies on freshwater aquatic invertebrates were found in the available literature, and therefore, all TRVs are based on acute duration endpoints.

Aquatic Plants

Standard toxicity tests conducted on aquatic plants, including aquatic macrophytes, freshwater diatoms, and algae, suggest that diflufenzopyr, dicamba, and Distinct® are highly toxic to aquatic plants. The green algae EC_{50} (0.1 mg/L) and NOAEL (0.0078 mg/L) were selected as the aquatic plant TRVs for

diflufenzopyr. The selected dicamba EC_{50} (0.1 mg a.i./L) was divided by an uncertainty factor of 3, to result in a dicamba NOAEL of 0.033 mg a.i./L. Based on the data above, the selected aquatic plant TRVs for Distinct® were established at 0.11 mg/L (EC_{50}) and 0.0023 mg/L (NOAEL).

Sulfometuron Methyl

Sulfometuron methyl is toxic to aquatic plants. Tests indicate that sulfometuron methyl has low acute toxicity to fish and aquatic invertebrates, though chronic toxicity can occur from long-term exposure. Sulfometuron methyl has a low potential to bioconcentrate in fish tissue. Overall, amphibians were more sensitive to sulfometuron methyl than most other aquatic biota.

Fish

Sulfometuron methyl is considered moderately toxic to fish. The coldwater 96-hour LC_{50} of >148 mg/L (the lower of the coldwater and warmwater fish endpoints) was selected as the acute TRV, and the warmwater fish NOAEL of 0.71 mg/L was used as the TRV for chronic effects.

Amphibians

Toxicity tests on frogs suggest that sulfometuron methyl is moderately toxic to amphibians. After 96-hours of exposure, 50% of the frogs exposed to sulfometuron methyl concentrations as low as 4.2 mg/L exhibited malformations. In chronic toxicity tests with this same species, malformations were observed in frogs exposed to concentrations as low as 1 mg/L, with no effects observed at 0.1 mg/L. The EC_{50} (4.2 mg/L) was selected as the amphibian acute TRV and the NOAEL (0.1 mg a.i./L) was selected as the chronic TRV.

Aquatic Invertebrates

Sulfometuron methyl is considered to have slight acute toxicity to aquatic invertebrates (chronic toxicity is higher). The LC_{50} (802 mg/L) was selected as the invertebrate acute TRV and the 21-day NOAEL (6.1 mg/L) was selected as the chronic TRV. However, one unverifiable report suggested that chronic toxicity to aquatic invertebrates may occur at concentrations as low as 0.18 mg/L.

Aquatic Plants

Sulfometuron methyl was most toxic to water milfoil, an aquatic macrophyte; tests on this species suggest that this herbicide is very highly toxic to aquatic plants. Adverse effects to 50% of the milfoil plants (the EC_{50}) were observed in concentrations containing 0.00012 mg a.i./L, and the EC_{25} was 0.00006 mg a.i./L (Roshon et al. 1999). The EC_{50} (0.00012 mg a.i./L) was selected as the aquatic plant acute TRV. Because a NOAEL was not reported, it was extrapolated by dividing the EC_{50} by an uncertainty factor of 3; the resulting NOAEL was (0.00004 mg a.i./L).

Tebuthiuron

Tebuthiuron has low toxicity to coldwater and warmwater fish and amphibians and slight toxicity to aquatic invertebrates. Amphibians were more tolerant of tebuthiuron than fish. While tebuthiuron was not highly toxic to aquatic plants under acute exposure conditions, chronic exposure resulted in toxicity at relatively low concentrations. Tebuthiuron is not expected to bioconcentrate in aquatic organisms.

Fish

Tebuthiuron is considered to have low acute toxicity to fish (chronic toxicity is higher). The warmwater 96-hour LC_{50} of 112 mg/L (the lower of the coldwater and warmwater fish endpoints) was selected as the acute TRV and the warmwater fish NOAEL of 9.3 mg/L was used as the TRV for chronic effects.

Amphibians

Toxicity tests on bullfrogs suggest that tebuthiuron is practically non-toxic to amphibians. After 96-hours of exposure, the LC_{50} concentration was determined to be less than 398 mg/L, but greater than 306 mg/L. The LC_{50} (398 mg/L) was selected as an amphibian acute TRV. Because there was no suitable NOAEL reported in the literature, the NOAEL was extrapolated from the LC_{50} using an uncertainty factor of 3; the resulting NOAEL TRV was 133 mg/L.

Aquatic Invertebrates

Tebuthiuron has low acute toxicity to aquatic invertebrates (chronic toxicity is higher). In 48-hour aquatic toxicity tests, acute toxicity was observed in aquatic invertebrates exposed to concentrations of 297 mg/L of tebuthiuron. In chronic tests with chironomids, adverse effects were observed in the

lowest concentration tested, 0.2 mg/L. No adverse effects were observed in snails exposed to 0.1 mg/L. The LC_{50} (297 mg/L) was selected as the invertebrate acute TRV. The snail NOAEL (0.1 mg/L) was selected as the invertebrate chronic TRV.

Aquatic Plants

Tebuthiuron appears to be highly toxic to aquatic plants. In acute toxicity tests, the EC_{50} was reported to be as low as 0.05 mg/L. NOAELs ranged from 0.013 mg/L for green algae to 0.18 for various algal species. The EC_{50} (0.05 mg/L) was selected as the aquatic plant acute TRV, and the NOAEL (0.013 mg/L) was selected as the aquatic plant chronic TRV.

Rare, Threatened, and Endangered Species Characterization

Rare, threatened, and endangered species have the potential to be impacted by herbicides applied for vegetation control. RTE species are of potential increased concern to screening level ERAs, which utilize surrogate species and generic assessment endpoints to evaluate potential risk, rather than examining site- and species-specific effects to individual RTE species. Several factors complicate the evaluation of the effects of herbicide applications on RTE species:

- Toxicological data specific to the species (and sometimes even class) of organism are often absent from the literature.
- The other assumptions involved in the ERA (e.g., rate of food consumption, surface-to-volume ratio) may differ for RTE species relative to selected surrogates and/or data for RTE species may be unavailable.
- The high level of protection afforded RTE species by regulation and policy suggests that secondary effects (e.g., potential loss of prey or cover), as well as site-specific circumstances that might result in higher rates of exposure, should receive more attention.

A common response to these issues is to design screening level ERAs to be highly conservative. This includes assumptions such as 100% exposure to an herbicide by simulating scenarios where the organism lives year-round (not likely for larger and migratory animals) in the most affected area (i.e., area of highest concentration), or that the organism consumes only food items that have been impacted by the herbicide. The screening level ERA incorporates additional conservatism in the assumptions used in the herbicide concentration models such as GLEAMS. Even with highly conservative assumptions in the ERA, however, concern may still exist over the potential risk to specific RTE species.

Potential direct impacts to receptors, including RTE species, are the measures of effect typically used in screening level ERAs. Direct impacts, such as those resulting from direct or indirect contact or ingestion were assessed in the ERAs by comparing calculated RQs to receptor-specific LOCs. An RQ greater than the LOC indicates the potential for risk to that receptor group via that exposure pathway. As described below, the selection of TRVs and the use of LOCs were pursued in a conservative fashion in order to provide a greater level of protection for RTE species.

The LOCs used in the ERA (Table C-1) were developed by the USEPA for the assessment of pesticides (LOC information obtained from Michael Davy, USEPA OPP on 13 June 2002). In essence, the LOCs act as uncertainty factors often applied to TRVs. For example, using an LOC of 1.0 provides the same result as dividing the TRV by 10. The LOC for avian and mammalian RTE species is 0.1 for acute and chronic exposures. For RTE fish and aquatic invertebrates, acute and chronic LOCs were 0.05 and 0.5, respectively. Therefore, up to a 20-fold uncertainty factor has been included in the TRVs for animal species. As noted below, such uncertainty factors provide a greater level of protection to the RTE to account for the factors listed in the beginning of this section.

For RTE plants, the exposure concentration, TRVs, and LOCs provided a direct assessment of potential impacts. For all exposure scenarios, the maximum modeled concentrations were used as the exposure concentrations. The TRVs used for RTE plants were selected based on highly sensitive endpoints, such as germination, rather than direct mortality of seedlings or larger plants. Conservatism has been built into the TRVs during their development (Section 3.1); the lowest suitable endpoint concentration available was used as the TRV for RTE plant species. Therefore, the RQ calculated for RTE plant exposure is intrinsically conservative. Given the conservative nature of the RQ, and consistent with USEPA policy, no additional levels of protection were required for the LOC (i.e., all plant LOCs are 1).

Protection levels for different species and individuals vary. Some organisms are protected on a community level; that is, slight risk to individual species may be acceptable if the community of organisms (e.g., wildflowers, terrestrial insects) is protected. Generally, community level organisms include plants and invertebrates. Other organisms are protected on a population level; that is, slight risk to individuals of a species may be acceptable if the population, as a whole, is not endangered. However, RTE species are protected as individuals; that is, risk to any single organism is considered unacceptable. This higher level of protection motivates much of the conservative approach taken in this ERA. Surrogate species were grouped by general life strategy: sessile (i.e., plants), water dwelling (i.e., fish), and mobile terrestrial vertebrates (i.e., birds, mammals, and reptiles). The approach to account for RTE species was divided along the same lines. Plants, fish, insects, and aquatic invertebrates were assessed using TRVs developed from surrogate species. All species from these taxa (identified in Appendix C of each ERA [ENSR 2005a-j]) were represented by the surrogate species presented in Tables C-3 and C-4.

Non-target Species Risk Characterization

The risk analysis evaluates the effects of the 10 herbicides on non-target terrestrial and aquatic flora and fauna. The risk that non-target flora and fauna face from herbicide applications depends on the toxicity of herbicides to individual species and the exposure of organisms to herbicides as a result of BLM applications. In order to address potential risks to ecological receptors, RQs were calculated by dividing the EEC for each of the previously described exposure pathways by the appropriate herbicide-specific TRV. Over 1,000 RQs were generated in each ERA. These RQs were then compared to LOC established by the USEPA OPP for all appropriate exposure scenarios and surrogate species. Ecological risk is implied when RQs exceeded the corresponding LOCs. LOCs are defined for the following risk presumption categories (see Table C-1):

- Acute high risk – the potential for acute risk is high.
- Acute restricted use – the potential for acute risk is high, but may be mitigated.
- Acute RTE species – RTE species may be adversely affected.
- Chronic risk – the potential for chronic risk is high.

Specific risks to applicable terrestrial and aquatic receptor groups from each individual herbicide are presented below according to the particular exposure pathway. See the tables and figures in Section 4 of the ERAs for each herbicide for risk information on ecological receptor groups according to herbicide application method. Indirect risks to salmonids are presented at the end of each herbicide section. In addition to direct effects of herbicides on salmonids and other fish species in stream habitats (i.e., mortality due to herbicide concentrations in water), reduction in vegetative cover or food supply may indirectly impact individuals or populations. No literature studies were identified that explicitly evaluated the direct or indirect effects of the herbicides on salmonids and their habitat; therefore, only qualitative estimates of indirect effects were possible. These estimates were accomplished by evaluating predicted impacts to prey items and vegetative cover in the stream scenarios of accidental direct spray, off-site drift, and surface runoff. An evaluation of impacts to non-target terrestrial plants was also included as part of the discussion of vegetative cover within the riparian zone. Food items for salmonids and other potential RTE species may include other fish species, aquatic invertebrates, and aquatic plants. It should be noted that the selected chronic fish TRV was based on a NOAEL for the fathead minnow (*Pimephales promelas*), which is much lower than any chronic values identified for salmonids. This indicates that chronic impacts to salmonids may be overestimated in this assessment.

Bromacil

Direct Spray

Terrestrial Wildlife

In general, acute RQs for terrestrial wildlife were below the most conservative LOC (0.1; acute risk RTE species at the typical application rate). However, direct spray of the pollinating insect resulted in elevated RQs at both the typical and maximum application rates. This is a conservative scenario that assumes the insect absorbs 100% of the herbicide with no degradation or limitations to uptake. Acute RQs above the most conservative LOC were also predicted at the maximum

TABLE C-5
Selected Toxicity Reference Values for Bromacil

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Receptors Included in the Food Web Model						
Terrestrial Animals						
Honeybee	193	ug/bee	NR	LD_{50}		Technical grade; no % a.i. listed
Large bird	> 5,000	mg/kg bw	8 d	LD_{50}	Mallard	Dietary; 80% a.i. product
Large bird	155	mg/kg bw-day	22 w	NOAEL	Mallard	98.1% a.i. product
Piscivorous bird	155	mg/kg bw-day	22 w	NOAEL	Mallard	98.1% a.i. product
Small bird	> 30,195	mg/kg bw	8 d	LD_{50}	Bobwhite quail	80% a.i. product
Small bird	936	mg/kg bw-day	21 w	NOAEL	Bobwhite quail	98.1% a.i. product
Small mammal	13.3	mg a.i./kg bw-day	2 y	NOAEL	Rat	
Small mammal - dermal	> 5000	mg a.i./kg bw	NR	LD_{50}	Rabbit	
Small mammal - ingestion	641	mg a.i./kg bw	NR	LD50	Rat	Water exposure; no diet available
Large mammal	641	mg a.i./kg bw	> 14 d	LD_{50}	Rat	Small mammal value used
Large mammal	4.65	mg a.i./kg bw-day	2 y	NOAEL	Dog	
Terrestrial Plants						
Typical species - direct spray, drift, dust	0.0023	lb a.i./acre	NR	EC_{25}	Rape	Vigor
RTE species - direct spray, drift, dust	0.0008	lb a.i./acre	NR	NOAEL	Rape	Extrapolated from EC_{25}; vigor
Typical species - runoff	0.188	lb a.i./acre	14 d	NOAEL	Soybean	Emergence; no germination data
RTE species - runoff	0.0117	lb a.i./acre	NR	NOAEL	Rape	Emergence; no germination data
Aquatic Species						
Aquatic invertebrates	65	mg a.i./L	48 h	EC_{50}	Water flea	
Fish	36	mg/L	96 h	LC_{50}	Rainbow trout	96.6% a.i. product
Aquatic plants and algae	0.0068	mg/L	5 d	EC_{50}	Green algae	96.5% a.i. product
Aquatic invertebrates	22	mg a.i./L	48 h	NOAEL	Water flea	Extrapolated from EC_{50}
Fish	0.33	mg a.i./L	64 d	NOAEL	Fathead minnow	Extrapolated from chronic LOAEL
Aquatic plants and algae	0.0023	mg/L	5 d	NOAEL	Green algae	Extrapolated from EC_{50}

TABLE C-5 (Cont.)
Selected Toxicity Reference Values for Bromacil

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Additional Endpoints						
Amphibian	230	mg a.i./L	48 h	LC_{50}	Tadpole	"Unacceptable"; no other data; no % a.i. provided
Amphibian	77	mg a.i./L	48 h	NOAEL	Tadpole	Extrapolated from LC_{50}; "unacceptable"; no other data; no % a.i. provided
Warmwater fish	71	mg/L	48 h	LC_{50}	Bluegill	No % a.i. provided
Warmwater fish	0.33	mg a.i./L	64 d	NOAEL	Fathead minnow	Extrapolated from chronic LOAEL
Coldwater fish	36	mg/L	96 h	LC_{50}	Rainbow trout	96.6% a.i. product
Coldwater fish	16.9	mg/L	96 h	NOAEL	Rainbow trout	96.6% a.i. product

[1] Piscivorous bird TRV = large bird chronic TRV; and fish TRV = Lower of coldwater and warmwater fish TRVs.
[2] Duration: h = hours; d = days; w = weeks; m = months; y = years; and NR = not reported.
[3] Toxicity endpoints for terrestrial animals: LD_{50} to address acute exposure; and NOAEL to address chronic exposure. Toxicity endpoints for terrestrial plants: EC_{25} to address direct spray, drift, and dust impacts on typical species; NOAEL to address direct spray, drift, and dust impacts on RTE species; highest germination NOAEL to address surface runoff impacts on typical species; and lowest germination NOAEL to address surface runoff impacts on RTE species. Toxicity endpoints for aquatic receptors: LC_{50} or EC_{50} to address acute exposure (appropriate toxicity endpoint for non-target aquatic plants will be an EC_{50}) and NOAEL to address chronic exposure.

TABLE C-6
Selected Toxicity Reference Values for Chlorsulfuron

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Receptors Included in the Food Web Model						
Terrestrial Animals						
Honeybee	> 25	µg/bee	48 h	LD_{50}		98.2% a.i. product
Large bird	> 1,500	mg/kg bw	8 d	LD_{50}	Mallard	Technical grade; no % a.i. listed
Large bird	99	mg/kg bw-day	1 generation	NOAEL	Mallard	98.2% a.i. product
Piscivorous bird	99	mg/kg bw-day	1 generation	NOAEL	Mallard	98.2% a.i. product
Small bird	> 16,970	mg/kg bw	8 d	LD_{50}	Bobwhite quail	Technical grade; no % a.i. listed
Small bird	100	mg/kg bw-day	27 w	NOAEL	Bobwhite quail	98.2% a.i. product
Small mammal	1,363	mg a.i./kg bw	NR	LD_{50}	Guinea pig	Small mammal value used
Small mammal – dermal	66	mg a.i./kg bw-day	1 y	NOAEL	Dog	
Small mammal – ingestion	5	mg a.i./kg bw-day	90 d	NOAEL	Rat	
Large mammal	> 3,400	mg a.i./kg bw	24 h	LD_{50}	Rabbit	
Large mammal	1,363	mg a.i./kg bw	NR	LD_{50}	Guinea pig	Water exposure; no diet available
Terrestrial Plants						
Typical species - direct spray, drift, dust	0.000063	lb a.i./acre	life cycle	EC_{25}	Canola	Extrapolated from NOAEL
RTE species - direct spray, drift, dust	0.000021	lb a.i./acre	life cycle	NOAEL	Canola	
Typical species - runoff	0.0157	lb a.i./acre	NR	NOAEL	Dyer's woad (weed)	Extrapolated from germination EC_{100}
RTE species - runoff	0.0052	lb a.i./acre	NR	NOAEL	Dyer's woad (weed)	Extrapolated from germination NOAEL
Aquatic Species						
Aquatic invertebrates	368.9	mg a.i./L	48 h	LC_{50}	Water flea (*D. magna*)	91% a.i. product
Fish	40	mg/L	96 h	LC_{50}	Brown trout	No % a.i. listed
Aquatic plants and algae	0.0007	mg a.i./L	96 h	EC_{50}	Duckweed	Technical grade; no % a.i. listed
Aquatic invertebrates	20	mg a.i./L	21 d	NOAEL	Water flea (*C. dubia*)	95.4% a.i. product
Fish	17	mg/L	96 h	NOAEL	Channel catfish	91% a.i. product; extrapolated from LC_{50}
Aquatic plants and algae	0.0004	mg a.i./L	96 h	NOAEL	Duckweed	Technical grade; no % a.i. listed

TABLE C-6 (Cont.)
Selected Toxicity Reference Values for Chlorsulfuron

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Additional Endpoints						
Amphibian	no data					
Amphibian	no data					
Warmwater fish	50	mg a.i./L	96 h	LC_{50}	Channel catfish	91% a.i. product
Warmwater fish	17	mg a.i./L	96 h	NOAEL	Channel catfish	91% a.i. product; extrapolated from LC_{50}
Coldwater fish	40	mg a.i./L	96 h	LC_{50}	Brown trout	No % a.i. listed
Coldwater fish	31	mg a.i./L	77 d	NOAEL	Rainbow trout	97.9% a.i. product

[1] Piscivorous bird TRV = large bird chronic TRV; and fish TRV = Lower of coldwater and warmwater fish TRVs.
[2] Duration: h = hours; d = days; w = weeks; m = months; y = years; and NR = not reported.
[3] Toxicity endpoints for terrestrial animals: LD_{50} to address acute exposure; and NOAEL to address chronic exposure. Toxicity endpoints for terrestrial plants: EC_{25} to address direct spray, drift, and dust impacts on typical species; NOAEL to address direct spray, drift, and dust impacts on RTE species; highest germination NOAEL to address surface runoff impacts on typical species; and lowest germination NOAEL to address surface runoff impacts on RTE species. Toxicity endpoints for aquatic receptors: LC_{50} or EC_{50} to address acute exposure (appropriate toxicity endpoint for non-target aquatic plants will be an EC_{50}) and NOAEL to address chronic exposure.

TABLE C-7
Selected Toxicity Reference Values for Diflufenzopyr

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Receptors Included in the Food Web Model						
Terrestrial Animals						
Honeybee	75	µg/bee	48 h	LD_{50}		Extrapolated from NOAEL;.99.4% a.i. product
Large bird	> 2,810	mg/kg bw	8 d	LD_{50}	Mallard	94.7% a.i. product
Large bird	105	mg/kg bw-day	21 w	NOAEL	Mallard	94.3% a.i. product
Piscivorous bird	105	mg/kg bw-day	21 w	NOAEL	Mallard	94.3% a.i. product
Small bird	> 16,970	mg/kg bw	8 d	LD_{50}	Bobwhite quail	94.7% a.i. product
Small bird	634	mg/kg bw-day	20 w	NOAEL	Bobwhite quail	94.3% a.i. product
Small mammal	42.2	mg/kg bw-day	2 generation	NOAEL	Rat	93% a.i. product
Small mammal - dermal	> 5,000	mg/kg bw	NR	LD_{50}	Rabbit	96.4% a.i. product
Small mammal - ingestion	3,300	mg/kg bw	NR	LD_{50}	Rat	Water exposure; no diet available; 98.1% a.i. product
Large mammal	3,300	mg/kg bw	NR	LD_{50}	Rat	Small mammal value
Large mammal	59	mg/kg bw-day	1 y	NOAEL	Dog	No % a.i. listed
Terrestrial Plants						
Typical species - direct spray, drift, dust	0.0008	lb a.i./acre	14 d	EC_{25}	Turnip	Based on emergence
RTE species - direct spray, drift, dust	0.0003	lb a.i./acre	14 d	NOAEL	Turnip	Extrapolated from EC_{25}
Typical species – runoff	0.028	lb a.i./acre	14 d	NOAEL	Tomato	No germination data; based on emergence
RTE species - runoff	0.0001	lb a.i./acre	NR	NOAEL	Turnip	No germination data; based on emergence
Aquatic Species						
Aquatic invertebrates	15	mg/L	48 h	EC_{50}	Water flea	94.7% a.i. product
Fish	106	mg/L	96 h	LC_{50}	Rainbow trout	97.4% a.i. product
Aquatic plants and algae	0.1	mg/L	5 d	EC_{50}	Green algae	99.5% a.i. product
Aquatic invertebrates	9.7	mg/L	48 h	NOAEL	Water flea	94.7% a.i. product
Fish	16	mg/L	96 h	NOAEL	Bluegill sunfish	97.4% a.i. product
Aquatic plants and algae	0.0078	mg/L	5 d	NOAEL	Green algae	99.5% a.i. product

TABLE C-7 (Cont.)
Selected Toxicity Reference Values for Diflufenzopyr

Receptor	Selected TRV[1]		Units	Duration[2]	Endpoint[3]	Species	Notes
Additional Endpoints							
Amphibian		no data					
Amphibian		no data					
Warmwater fish	>	135	mg/L	96 h	LC_{50}	Bluegill sunfish	97.4% a.i. product
Warmwater fish		16	mg/L	96 h	NOAEL	Bluegill sunfish	97.4% a.i. product
Coldwater fish		106	mg/L	96 h	LC_{50}	Rainbow trout	97.4% a.i. product
Coldwater fish		80	mg/L	96 h	NOAEL	Rainbow trout	97.4% a.i. product

[1] Piscivorous bird TRV = large bird chronic TRV; and fish TRV = Lower of coldwater and warmwater fish TRVs.
[2] Duration: h = hours; d = days; w = weeks; m = months; y = years; and NR = not reported.
[3] Toxicity endpoints for terrestrial animals: LD_{50} to address acute exposure; and NOAEL to address chronic exposure. Toxicity endpoints for terrestrial plants: EC_{25} to address direct spray, drift, and dust impacts on typical species; NOAEL to address direct spray, drift, and dust impacts on RTE species; highest germination NOAEL to address surface runoff impacts on typical species; and lowest germination NOAEL to address surface runoff impacts on RTE species. Toxicity endpoints for aquatic receptors: LC_{50} or EC_{50} to address acute exposure (appropriate toxicity endpoint for non-target aquatic plants will be an EC_{50}) and NOAEL to address chronic exposure.

TABLE C-8
Selected Toxicity Reference Values for Diquat

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Receptors Included in the Food Web Model						
Terrestrial Animals						
Honeybee	47	µg/bee	5 d	LD_{50}		Extrapolated from NOAEL; no % a.i. listed
Large bird	215	mg a.i./kg bw	NR	LD_{50}	Ring neck pheasant	
Large bird	0.6	mg a.i./kg bw-day	1 generation	NOAEL	Mallard	
Piscivorous bird	0.6	mg a.i./kg bw-day	1 generation	NOAEL	Mallard	
Small bird	150	mg a.i./kg bw	NR	LD_{50}	Japanese quail	
Small bird	> 12	mg a.i./kg bw-day	NR	NOAEL	Bobwhite quail	
Small mammal	0.8	mg a.i./kg bw-day	104 w	NOAEL	Rat	
Small mammal - dermal	262	mg a.i./kg bw	NR	LD_{50}	Rabbit	
Small mammal - ingestion	121	mgkg bw	> 14 d	LD_{50}	Rat	Water exposure; no diet available; no % a.i. listed
Large mammal	121	mg/kg bw	> 14 d	LD_{50}	Rat	Small mammal value; no % a.i. listed
Large mammal	0.5	mg a.i./kg bw-day	1 y	NOAEL	Dog	
Terrestrial Plants						
Typical Species - direct spray, drift	0.0047	lb a.i./acre	NR	EC_{25}	Cotton	Vigor
RTE Species - direct spray, drift	0.0016	lb a.i./acre	NR	NOAEL	Cotton	Vigor; extrapolated from EC_{25}
Aquatic Species						
Aquatic invertebrates	0.14	mg/L	48 h	EC_{50}	Amphipod	No % a.i. listed
Fish	0.75	mg a.i./L	96 h	LC_{50}	Walleye	
Aquatic plants and algae	0.00075	mg a.i./L	14 d	EC_{50}	Giant duckweed	35.3% a.i. product
Aquatic invertebrates	0.044	mg a.i./L	life cycle	NOAEL	Water flea	41.4% a.i. product
Fish	0.17	mg a.i./L	NR	NOAEL	Rainbow trout	Extrapolated from LOAEL / swimming speed
Aquatic plants and algae	0.0003	mg a.i./L	14 d	NOAEL	Giant duckweed	Extrapolated from EC_{50}

TABLE C-8 (Cont.)
Selected Toxicity Reference Values for Diquat

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Additional Endpoints						
Amphibian	no data					
Amphibian	2	mg/L	16 d	NOAEL	Northern leopard frog	No % a.i. listed
Warmwater fish	0.75	mg a.i./L	96 h	LC_{50}	Walleye	
Warmwater fish	0.58	mg a.i./L	34 d	NOAEL	Fathead minnow	41% a.i. product
Coldwater fish	14.83	mg/L	96 h	LC_{50}	Rainbow trout	19.8% a.i. product
Coldwater fish	0.17	mg a.i./L	NR	NOAEL	Rainbow trout	Extrapolated from LOAEL/swimming speed

[1] Piscivorous bird TRV = large bird chronic TRV; and fish TRV = Lower of coldwater and warmwater fish TRVs.
[2] Duration: h = hours; d = days; w = weeks; m = months; y = years; and NR = not reported.
[3] Toxicity endpoints for terrestrial animals: LD_{50} to address acute exposure; and NOAEL to address chronic exposure. Toxicity endpoints for terrestrial plants: EC_{25} to address direct spray, drift, and dust impacts on typical species; NOAEL to address direct spray, drift, and dust impacts on RTE species; highest germination NOAEL to address surface runoff impacts on typical species; and lowest germination NOAEL to address surface runoff impacts on RTE species. Toxicity endpoints for aquatic receptors: LC_{50} or EC_{50} to address acute exposure (appropriate toxicity endpoint for non-target aquatic plants will be an EC_{50}) and NOAEL to address chronic exposure.

TABLE C-9
Selected Toxicity Reference Values for Diuron

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Receptors Included in the Food Web Model						
Terrestrial Animals						
Honeybee	145.03	μg/bee	48 h	LD_{50}		Technical grade; no % a.i. listed
Large bird	865	mg/kg bw	8 d	LD_{50}	Mallard	No % a.i. listed
Large bird	58	mg/kg bw-day	8 d	NOAEL	Mallard	No % a.i. listed; extrapolated from LD_{50}
Piscivorous bird	1,017	mg a.i./kg bw	NR	LD_{50}	Rat	Small mammal value
Small bird	0.6	mg a.i./kg bw-day	2 y	NOAEL	Dog	
Small bird	58	mg/kg bw-day	8 d	NOAEL	Mallard	No % a.i. listed; extrapolated from LD_{50}
Small mammal	5,225	mg/kg bw	8 d	LD_{50}	Bobwhite quail	No % a.i. listed
Small mammal – dermal	348	mg/kg bw-day	8 d	NOAEL	Bobwhite quail	No % a.i. listed; extrapolated from LD_{50}
Small mammal – ingestion	2.5	mg a.i./kg bw-day	3 m	NOAEL	Rat	
Large mammal	> 2,500	mg a.i./kg bw	> 14 d	LD_{50}	Unknown	
Large mammal	1017	mg a.i./kg bw	NR	LD_{50}	Rat	Water exposure; no diet available
Terrestrial Plants						
Typical species - direct spray, drift, dust	0.08	lb a.i./acre	NR	EC_{25}	Tomato	Based on seed emergence
RTE species - direct spray, drift, dust	0.001	lb a.i./acre	21 d	NOAEL		Vigor
Typical species - runoff	12	lb a.i./acre	14 d	NOAEL	Garden pea; soybean	Based on seed emergence
RTE species - runoff	0.047	lb a.i./acre	NR	NOAEL	Tomato	Based on seed emergence
Aquatic Species						
Aquatic invertebrates	0.16	mg/L	96 h	EC_{50}	Scud (*Gammarus*)	95% a.i. product
Fish	0.71	mg/L	96 h	LC_{50}	Cutthroat trout	95% a.i. product
Aquatic plants and algae	0.0013	mg/L	NR	EC_{50}	*Chlorella pyrenoidosa* (algae)	No % a.i. listed
Aquatic invertebrates	0.067	mg/L	28 d	NOAEL	Daphnid	98% a.i. product; extrapolated from chronic LOAEL
Fish	0.033	mg/L	chronic	NOAEL	Fathead minnow	98.6% a.i. product
Aquatic plants and algae	0.00044	mg/L	96 h	NOAEL	*Selenastrum* (algae)	98.6% a.i. product

TABLE C-9 (Cont.)
Selected Toxicity Reference Values for Diuron

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Additional Endpoints						
Amphibian	12.7	mg/L	21 d	LC_{50}	Bullfrog	99.8% a.i. product
Amphibian	7.6	mg/L	21 d	NOAEL	Bullfrog	99.8% a.i. product
Warmwater fish	2.8	mg/L	96 h	LC_{50}	Bluegill sunfish	95% a.i. product
Warmwater fish	0.03	mg/L	chronic	NOAEL	Fathead minnow	98.6% a.i. product
Coldwater fish	0.71	mg/L	96 h	LC_{50}	Cutthroat trout	95% a.i. product
Coldwater fish	0.24	mg/L	96 h	NOAEL	Cutthroat trout	95% a.i. product; extrapolated from LC50

[1] Piscivorous bird TRV = large bird chronic TRV; and fish TRV = Lower of coldwater and warmwater fish TRVs.
[2] Duration: h = hours; d = days; w = weeks; m = months; y = years; and NR = not reported.
[3] Toxicity endpoints for terrestrial animals: LD_{50} to address acute exposure; and NOAEL to address chronic exposure. Toxicity endpoints for terrestrial plants: EC_{25} to address direct spray, drift, and dust impacts on typical species; NOAEL to address direct spray, drift, and dust impacts on RTE species; highest germination NOAEL to address surface runoff impacts on typical species; and lowest germination NOAEL to address surface runoff impacts on RTE species. Toxicity endpoints for aquatic receptors: LC_{50} or EC_{50} to address acute exposure (appropriate toxicity endpoint for non-target aquatic plants will be an EC_{50}) and NOAEL to address chronic exposure.

TABLE C-10
Selected Toxicity Reference Values for Fluridone

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Receptors Included in the Food Web Model						
Terrestrial Animals						
Honeybee	1,088	µg/bee	48 h	LD_{50}		Extrapolated from NOAEL; 33.3% a.i. product
Large bird	> 2,270	mg/kg bw	8 d	LD_{50}	Mallard	Technical grade; assumed 95 - 97% a.i.
Large bird	100	mg a.i./kg bw-day	1 generation	NOAEL	Mallard	Reproduction
Piscivorous bird	100	mg a.i./kg bw-day	1 generation	NOAEL	Mallard	
Small bird	> 13,135	mg/kg bw	8 d	LD_{50}	Bobwhite quail	Technical grade; assumed 95 - 97% a.i.
Small bird	604	mg a.i./kg bw-day	1 generation	NOAEL	Bobwhite quail	Reproduction
Small mammal	8	mg a.i./kg bw-day	2 y	NOAEL	Rat	
Small mammal - dermal	> 5,000	mg a.i./kg bw	8 d	LD_{50}	Rabbit	
Small mammal - ingestion	> 10,000	mg a.i./kg bw	NR	LD_{50}	Mouse and rat	Water exposure; no diet available
Large mammal	> 10,000	mg a.i./kg bw	NR	LD_{50}	Mouse and rat	Small mammal value
Large mammal	75	mg a.i./kg bw-day	1 y	NOAEL	Beagle	
Terrestrial Plants						
Terrestrial plants - typical species	no data					
Terrestrial plants- RTE species	no data					
Aquatic Species						
Aquatic invertebrates	0.14	mg/L	48 h	EC_{50}	Amphipod	No % a.i. listed
Fish	0.75	mg a.i./L	96 h	LC_{50}	Walleye	
Aquatic plants and algae	0.00075	mg a.i./L	14 d	EC_{50}	Giant duckweed	35.3% a.i. product
Aquatic invertebrates	0.044	mg a.i./L	life cycle	NOAEL	Water flea	41.4% a.i. product
Fish	0.17	mg a.i./L	NR	NOAEL	Rainbow trout	Extrapolated from LOAEL / swimming speed
Aquatic plants and algae	0.0003	mg a.i./L	14 d	NOAEL	Giant duckweed	Extrapolated from EC_{50}

TABLE C-10 (Cont.)
Selected Toxicity Reference Values for Fluridone

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Additional Endpoints						
Amphibian	no data					
Amphibian	no data					
Warmwater fish	8.2	mg/L	96 h	LC_{50}	Channel catfish	98 – 99% a.i. product
Warmwater fish	0.5	mg/L	life cycle	NOAEL	Fathead minnow	98 – 99% a.i. product
Coldwater fish	4.2	mg/L	96 h	LC_{50}	Rainbow trout	98 – 99% a.i. product
Coldwater fish	1.4	mg/L	96 h	NOAEL	Rainbow trout	Extrapolated from LC_{50}

[1] Piscivorous bird TRV = large bird chronic TRV; and fish TRV = Lower of coldwater and warmwater fish TRVs.
[2] Duration: h = hours; d = days; w = weeks; m = months; y = years; and NR = not reported.
[3] Toxicity endpoints for terrestrial animals: LD_{50} to address acute exposure; and NOAEL to address chronic exposure. Toxicity endpoints for terrestrial plants: EC_{25} to address direct spray, drift, and dust impacts on typical species; NOAEL to address direct spray, drift, and dust impacts on RTE species; highest germination NOAEL to address surface runoff impacts on typical species; and lowest germination NOAEL to address surface runoff impacts on RTE species. Toxicity endpoints for aquatic receptors: LC_{50} or EC_{50} to address acute exposure (appropriate toxicity endpoint for non-target aquatic plants will be an EC_{50}) and NOAEL to address chronic exposure.

TABLE C-11
Selected Toxicity Reference Values for Imazapic

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Receptors Included in the Food Web Model						
Terrestrial Animals						
Honeybee	> 100	µg/bee	48 h	LD_{50}		93.7% a.i. product
Large bird	> 2,500	mg a.i./kg bw	8 d	LD_{50}	Mallard	93.7% a.i. product
Large bird	65	mg a.i./kg bw-day	22 w	NOAEL	Mallard	96.9% a.i. product
Piscivorous bird	65	mg a.i./kg bw-day	22 w	NOAEL	Mallard	96.9% a.i. product
Small bird	> 15,095	mg a.i./kg bw	8 d	LD_{50}	Bobwhite quail	93.7% a.i. product
Small bird	113	mg a.i./kg bw-day	24 w	NOAEL	Bobwhite quail	96.9% a.i. product
Small mammal	1,728	mg/kg bw-day	3 m	NOAEL	Rat	Technical grade; no % a.i. listed; extrapolated from LOAEL
Small mammal - dermal	> 2,000	mg/kg bw	NR	LD_{50}	Rabbit	No % a.i. listed
Small mammal - ingestion	> 5,000	mg a.i./kg bw	NR	LD_{50}	Rat	Water exposure
Large mammal	> 5,000	mg a.i./kg bw	NR	LD_{50}	Rat	Same as small mammal value; water exposure
Large mammal	46	mg/kg bw-day	1 y	NOAEL	Dog	Technical grade; no % a.i. listed; extrapolated from LOAEL
Terrestrial Plants						
Typical species - direct spray, drift, dust	0.01	lb a.i./acre	14 d	EC_{25}	Corn	Based on seed emergence
RTE species - direct spray, drift, dust	0.008	lb a.i./acre	21 d	NOAEL	Soybean	Based on vegetative vigor
Typical species – runoff	0.064	lb a.i./acre	6 d	NOAEL	Vegetable crops	Based on seed germination
RTE species - runoff	0.032	lb a.i./acre	6 d	NOAEL	Onion	Based on seed germination
Aquatic Species						
Aquatic invertebrates	> 100	mg/L	48 h	LD_{50}	Water flea	93.7% a.i. product
Fish	> 100	mg/L	96 h	LD_{50}	Rainbow trout	93.7% a.i. product
Aquatic plants and algae	0.0042	mg/L	14 d	EC_{25}	Duckweed	96.9% a.i. product
Aquatic invertebrates	96	mg/L	21 d	NOAEL, ELEL	Water flea	97% a.i. product
Fish	33	mg/L	96 h	NOAEL	Rainbow trout	93.7% a.i. product; extrapolated from 96 h LC_{50}
Aquatic plants and algae	0.0026	mg/L	14 d	NOAEL	Duckweed	96.9% a.i. product

TABLE C-11 (Cont.)
Selected Toxicity Reference Values for Imazapic

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Additional Endpoints						
Amphibian	no data					
Amphibian	no data					
Warmwater fish	> 100	mg/L	96 h	LD_{50}	Bluegill	93.7% a.i. product
Warmwater fish	96	mg/L	32 d	NOAEL	Fathead minnow	97% a.i. product
Coldwater fish	> 100	mg/L	96 h	LD_{50}	Rainbow trout	93.7% a.i. product
Coldwater fish	33	mg/L	96 h	NOAEL	Rainbow trout	93.7% a.i. product; extrapolated from 96 h LC_{50}

[1] Piscivorous bird TRV = large bird chronic TRV; and fish TRV = Lower of coldwater and warmwater fish TRVs.
[2] Duration: h = hours; d = days; w = weeks; m = months; y = years; and NR = not reported.
[3] Toxicity endpoints for terrestrial animals: LD_{50} to address acute exposure; and NOAEL to address chronic exposure. Toxicity endpoints for terrestrial plants: EC_{25} to address direct spray, drift, and dust impacts on typical species; NOAEL to address direct spray, drift, and dust impacts on RTE species; highest germination NOAEL to address surface runoff impacts on typical species; and lowest germination NOAEL to address surface runoff impacts on RTE species. Toxicity endpoints for aquatic receptors: LC_{50} or EC_{50} to address acute exposure (appropriate toxicity endpoint for non-target aquatic plants will be an EC_{50}) and NOAEL to address chronic exposure.

TABLE C-12
Selected Toxicity Reference Values for Overdrive®

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Receptors Included in the Food Web Model						
Terrestrial Animals						
Honeybee	75	ug/bee	48 h	LD_{50}		Extrapolated from NOAE; 9.4% a.i. product
Large bird	> 2,810	mg/kg bw	8 d	LD_{50}	Mallard	94.7% a.i. product
Large bird	105	mg/kg bw-day	21 w	NOAEL	Mallard	94.3% a.i. product
Piscivorous bird	3,300	mg/kg bw		LD_{50}	Rat	Small mammal value
Small bird	59	mg/kg bw-day	1 y	NOAEL	Dog	No % a.i. listed
Small bird	105	mg/kg bw-day	8 d	NOAEL	Mallard	94.7% a.i. product
Small mammal	> 16,970	mg/kg bw	8 d	LD_{50}	Bobwhite quail	94.7% a.i. product
Small mammal - dermal	634	mg/kg bw-day	20 w	NOAEL	Bobwhite quail	94.3% a.i. product
Small mammal - ingestion	42.2	mg/kg bw-day	2 generation	NOAEL	Rat	93% a.i. product
Large mammal	> 5,000	mg/kg bw		LD_{50}	Rabbit	96.4% a.i. product
Large mammal	3,300	mg/kg bw		LD_{50}	Rat	Water exposure; no diet available; 98.1% a.i. product
Terrestrial Plants						
Typical species - direct spray, drift, dust	0.0008	lb a.i./acre	14 d	EC_{25}	Turnip	Based on emergence
RTE species - direct spray, drift, dust	0.0003	lb a.i./acre	14 d	NOAEL	Turnip	Extrapolated from EC25
Typical species - runoff	0.028	lb a.i./acre	14 d	NOAEL	Tomato	No germination data; based on emergence
RTE species - runoff	0.0001	lb a.i./acre	NR	NOAEL	Turnip	No germination data; based on emergence
Aquatic Species						
Aquatic invertebrates	15	mg/L	48 h	EC_{50}	*D. magna*	94.7% a.i. product
Fish	106	mg/L	96 h	LC_{50}	Rainbow trout	97.4% a.i. product
Aquatic plants and algae	0.1	mg/L	5 d	EC_{50}	Green algae	99.5% a.i. product
Aquatic invertebrates	9.7	mg/L	48 h	NOAEL	*D. magna*	94.7% a.i. product
Fish	16	mg/L	96 h	NOAEL	Bluegill sunfish	97.4% a.i. product
Aquatic plants and algae	0.0078	mg/L	5 d	NOAEL	Green algae	99.5% a.i. product

TABLE C-12 (Cont.)
Selected Toxicity Reference Values for Overdrive®

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Additional Endpoints						
Amphibian	no data					
Amphibian	no data					
Warmwater fish	> 100	mg/L	96 h	LD_{50}	Bluegill	93.7% a.i. product
Warmwater fish	96	mg/L	32 d	NOAEL	Fathead minnow	97% a.i. product
Coldwater fish	> 100	mg/L	96 h	LD_{50}	Rainbow trout	93.7% a.i. product
Coldwater fish	33	mg/L	96 h	NOAEL	Rainbow trout	93.7% a.i. product; extrapolated from 96 h LC_{50}

[1] Piscivorous bird TRV = large bird chronic TRV; and fish TRV = Lower of coldwater and warmwater fish TRVs.
[2] Duration: h = hours; d = days; w = weeks; m = months; y = years; and NR = not reported.
[3] Toxicity endpoints for terrestrial animals: LD_{50} to address acute exposure; and NOAEL to address chronic exposure. Toxicity endpoints for terrestrial plants: EC_{25} to address direct spray, drift, and dust impacts on typical species; NOAEL to address direct spray, drift, and dust impacts on RTE species; highest germination NOAEL to address surface runoff impacts on typical species; and lowest germination NOAEL to address surface runoff impacts on RTE species. Toxicity endpoints for aquatic receptors: LC_{50} or EC_{50} to address acute exposure (appropriate toxicity endpoint for non-target aquatic plants will be an EC_{50}) and NOAEL to address chronic exposure.

TABLE C-13
Selected Toxicity Reference Values for Sulfometuron Methyl

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Receptors Included in the Food Web Model						
Terrestrial Animals						
Honeybee	300	µg/bee	48 h	LD_{50}		Extrapolated from NOAEL; 99.8% a.i. product
Large bird	> 2,300	mg a.i./kg bw	8 d	LD_{50}	Mallard	
Large bird	153	mg a.i./kg bw-day	8 d	NOAEL	Mallard	Extrapolated from LD_{50}
Piscivorous bird	153	mg a.i./kg bw-day	8 d	NOAEL	Mallard	
Small bird	> 16970	mg a.i./kg bw	8 d	LD_{50}	Bobwhite quail	95.2% a.i. product
Small bird	1,131	mg a.i./kg bw-day	8 d	NOAEL	Bobwhite quail	Extrapolated from LD_{50}; 95.2% a.i. product
Small mammal	18	mg a.i./kg bw-day	18 m	NOAEL	Mouse	
Small mammal - dermal	> 8,000	mg a.i./kg bw		LD_{50}	Rabbit	
Small mammal - ingestion	> 5,000	mg a.i./kg bw		LD_{50}	Rat	Water exposure; no diet available
Large mammal	> 5,000	mg a.i./kg bw		LD_{50}	Rat	Small mammal
Large mammal	28	mg a.i./kg bw-day	1 y	NOAEL	Dog	
Terrestrial Plants						
Typical species-direct spray, drift, dust	0.22	lb a.i./acre		EC_{25}	White mustard	Growth
RTE species-direct spray, drift, dust	0.000028	lb a.i./acre	14 d	NOAEL	Sorghum	Based on seed emergence
Typical species – runoff	1.12	lb a.i./acre		NOAEL	Leafy spurge	Based on seed emergence
RTE species – runoff	0.000028	lb a.i./acre		NOAEL	Sorghum, sugar beet	Based on seed emergence
Aquatic Species						
Aquatic invertebrates	802	mg/L		LC_{50}	Cladoceran	93% a.i. product
Fish	> 148	mg/L	96 h	LC_{50}	Rainbow trout	99.6% a.i. product
Aquatic plants and algae	0.00012	mg a.i./L		EC_{50}	Water milfoil	Based on root mass
Aquatic invertebrates	6.1	mg/L	21 d	NOAEL	Water flea (*D. magna*)	Extrapolated from EC_{50}; 99.1% a.i. product
Fish	0.71	mg/L	chronic	NOAEL	Fathead minnow	95% a.i. product
Aquatic plants and algae	0.00004	mg a.i./L		NOAEL	Water milfoil	Extrapolated from EC_{50}

TABLE C-13 (Cont.)
Selected Toxicity Reference Values for Sulfometuron Methyl

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Additional Endpoints						
Amphibian	4.2	mg/L		EC_{50}	African clawed frog	85% a.i. product
Amphibian	0.1	mg/L	chronic	NOAEL	African clawed frog	85% a.i. product
Warmwater fish	> 150	mg/L		LC_{50}	Bluegill sunfish	99.6% a.i. product
Warmwater fish	0.71	mg/L	chronic	NOAEL	Fathead minnow	95% a.i. product
Coldwater fish	> 148	mg/L	96 h	LC_{50}	Rainbow trout	99.6% a.i. product
Coldwater fish	49	mg/L	96 h	NOAEL	Rainbow trout	Extrapolated from LC_{50}; 99.6% a.i. product

[1] Piscivorous bird TRV = large bird chronic TRV; and fish TRV = Lower of coldwater and warmwater fish TRVs.
[2] Duration: h = hours; d = days; w = weeks; m = months; y = years; and NR = not reported.
[3] Toxicity endpoints for terrestrial animals: LD_{50} to address acute exposure; and NOAEL to address chronic exposure. Toxicity endpoints for terrestrial plants: EC_{25} to address direct spray, drift, and dust impacts on typical species; NOAEL to address direct spray, drift, and dust impacts on RTE species; highest germination NOAEL to address surface runoff impacts on typical species; and lowest germination NOAEL to address surface runoff impacts on RTE species. Toxicity endpoints for aquatic receptors: LC_{50} or EC_{50} to address acute exposure (appropriate toxicity endpoint for non-target aquatic plants will be an EC_{50}) and NOAEL to address chronic exposure.

TABLE C-14
Selected Toxicity Reference Values for Tebuthiuron

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Receptors Included in the Food Web Model						
Terrestrial Animals						
Honeybee	30	µg/bee	NR	LD_{50}		
Large bird	> 2,545	mg a.i./kg bw	8 d	LD_{50}	Mallard	
Large bird	1,000	mg a.i./kg bw-day	30 d	NOAEL	Chicken	
Piscivorous bird	1,000	mg a.i./kg bw-day	30 d	NOAEL	Chicken	
Small bird	> 15,440	mg a.i./kg bw	8 d	LD_{50}	Bobwhite quail	
Small bird	1,029	mg a.i./kg bw-day	8 d	NOAEL	Bobwhite quail	Extrapolated from LD_{50}
Small mammal	7	mg a.i./kg bw-day	2 generations	NOAEL	Rat	
Small mammal - dermal	> 5,000	mg a.i./kg bw	NR	LD_{50}	Rabbit	
Small mammal - ingestion	58	mg a.i./kg bw	acute	LD_{50}	Mouse	Water exposure; no diet available
Large mammal	> 500	mg a.i./kg bw	acute	LD_{50}	Dog	
Large mammal	12.5	mg a.i./kg bw-day	90 d	NOAEL	Dog	Water exposure; no diet available
Terrestrial Plants						
Typical species - direct spray, drift, dust	0.03	lb a.i./acre	NR	EC_{25}	Cabbage	Based on seed emergence
RTE species-direct spray, drift, dust	0.01	lb a.i./acre	NR	NOAEL	Cabbage	Extrapolated from EC_{25}; based on seed emergence
Typical species – runoff	> 6	lb a.i./acre	5 d	NOAEL	10 species	Based on seed germination
RTE species – runoff	0.01	lb a.i./acre	5d	NOAEL	Cabbage	Extrapolated from EC_{25}; based on seed emergence
Aquatic Species						
Aquatic invertebrates	802	mg/L		LC_{50}	Cladoceran	93% a.i. product
Fish	> 148	mg/L	96 h	LC_{50}	Rainbow trout	99.6% a.i. product
Aquatic plants and algae	0.00012	mg a.i./L		EC_{50}	Water milfoil	Based on root mass
Aquatic invertebrates	6.1	mg/L	21 d	NOAEL	Water flea (*D. magna*)	Extrapolated from EC_{50}; 99.1% a.i. product
Fish	0.71	mg/L	chronic	NOAEL	Fathead minnow	95% a.i. product
Aquatic plants and algae	0.00004	mg a.i./L		NOAEL	Water milfoil	Extrapolated from EC_{50}

TABLE C-14 (Cont.)
Selected Toxicity Reference Values for Tebuthiuron

Receptor	Selected TRV[1]	Units	Duration[2]	Endpoint[3]	Species	Notes
Additional Endpoints						
Amphibian	< 398	mg/L	96 h	LC_{50}	Bullfrog	> 97% a.i. product
Amphibian	133	mg/L	96 h	NOAEL	Bullfrog	Extrapolated from LC_{50}
Warmwater fish	112	mg/L	96 h	LC_{50}	Bluegill sunfish	~ 100% a.i. product
Warmwater fish	> 9.3	mg a.i./L	33 d	NOAEL	Fathead minnow	Growth
Coldwater fish	115	mg/L	96 h	LC_{50}	Rainbow trout	> 97% a.i. product
Coldwater fish	26	mg/L	45 d	NOAEL	Rainbow trout	Growth; 98% a.i. product

[1] Piscivorous bird TRV = large bird chronic TRV; and fish TRV = Lower of coldwater and warmwater fish TRVs.

[2] Duration: h = hours; d = days; w = weeks; m = months; y = years; and NR = not reported.

[3] Toxicity endpoints for terrestrial animals: LD_{50} to address acute exposure; and NOAEL to address chronic exposure. Toxicity endpoints for terrestrial plants: EC_{25} to address direct spray, drift, and dust impacts on typical species; NOAEL to address direct spray, drift, and dust impacts on RTE species; highest germination NOAEL to address surface runoff impacts on typical species; and lowest germination NOAEL to address surface runoff impacts on RTE species. Toxicity endpoints for aquatic receptors: LC_{50} or EC_{50} to address acute exposure (appropriate toxicity endpoint for non-target aquatic plants will be an EC_{50}) and NOAEL to address chronic exposure.

application rate for ingestion of contaminated prey by the small mammalian herbivore, the large mammalian herbivore, the large avian herbivore, and the large carnivorous mammal, with the exception of the large mammalian herbivore with an RQ of 1.3, these RQs were below LOC for acute risk.

Risk quotients for chronic ingestion scenarios were below the associated LOC of 1, except the ingestion of contaminated prey by the small avian insectivore and the large mammalian carnivore. Chronic RQs for the small mammalian herbivore and the large avian herbivore were just above the LOC at the maximum application rate. The large mammalian herbivore scenario resulted in elevated chronic RQs at both the typical and maximum application rates.

Therefore, direct spray impacts may pose a risk to insects and large herbivores, primarily when the maximum application rate is used.

Non-target Plants – Terrestrial and Aquatic

As expected, because of the mode of action of herbicides, RQs for non-target terrestrial and aquatic plants impacted by direct spray were above the plant LOC of 1 for all modeled scenarios. RQs for direct spray of non-target terrestrial plants ranged from 1,740 to 15,000. RQs for non-target aquatic plants impacted by accidental direct spray of the pond or stream ranged from 66 to 2,924. Therefore, direct spray impacts are likely pose a risk to plants in both aquatic and terrestrial environments.

Fish and Aquatic Invertebrates

Acute toxicity RQs for aquatic invertebrates in the pond were below the most conservative LOC of 0.05 (acute RTE species), indicating that direct spray impacts are not likely to pose a risk to these aquatic species. The predicted acute toxicity RQs for fish and aquatic invertebrates in the stream were above the most conservative LOC of 0.05 (acute risk RTE species). These results indicate the potential for acute risk to aquatic species, especially RTE species, in a stream accidentally sprayed with bromacil.

The chronic RQs for the accidental direct spray over the pond and stream scenarios were below the most conservative chronic LOC (0.5; chronic risk RTE species) for all aquatic invertebrate scenarios. These results indicate that impacts from direct spray are generally not likely to pose chronic risk to these aquatic species. However, chronic RQs for fish in the pond and stream impacted by accidental direct spray were above the chronic LOCs for RTE species and general chronic risk in most scenarios. This indicates the potential for chronic risk to fish due to accidental direct spray.

Off-site Drift

Non-target Plants – Terrestrial and Aquatic

All of the RQs for non-target terrestrial plants affected by off-site drift were above the plant LOC of 1. The RQs ranged from 1.17 (predicted 900 ft from application with a low boom at the typical application rate) to 312 (predicted 25 ft from application with a high boom at the maximum application rate). These results indicate that impacts from off-site drift pose a risk to non-target terrestrial plant species within 900 ft of the application area.

The majority of the RQs for non-target aquatic plants affected by off-site drift at the typical application rate were below the plant LOC of 1. However, RQs above the LOC were predicted for six chronic waterbody scenarios (25 ft from low boom applications, 25 and 100 ft from high boom applications in both the pond and the stream) and one acute stream scenario (25 ft from high boom application).

At the maximum application rate, off-site drift to the stream and pond resulted in elevated acute RQs 25 ft from low boom applications and 25 and 100 ft from high boom applications. Elevated chronic RQs were predicted in both waterbodies for these three scenarios as well as for the scenario of 100 ft from low boom applications. These results indicate that impacts from off-site drift may pose a risk to aquatic plants within 100 ft of the application area. In addition, slightly more elevated risks were predicted in the stream than in the pond.

Fish and Aquatic Invertebrates

Acute toxicity RQs for fish and aquatic invertebrates were all below the most conservative LOC of 0.05 (acute RTE species). All chronic RQs were well below the LOC for chronic risk to RTE species (0.5). These results indicate that impacts from off-site drift are not likely to pose acute or chronic risk to these aquatic species.

Piscivorous Birds

Risk quotients for piscivorous birds were all well below the most conservative terrestrial animal LOC (0.1), indicating that this scenario is not likely to pose a risk to piscivorous birds.

Surface Runoff

Non-target Plants – Terrestrial and Aquatic

Risk quotients for typical non-target terrestrial plant species affected by surface runoff were all below the plant LOC of 1, indicating that transport due to surface runoff is not likely to pose a risk to these receptors. Most RQs for RTE non-target terrestrial plant species were also below the plant LOC of 1; however, four scenarios did result in elevated RQs. These scenarios were for the base watershed with clay soils and greater than 100 in of rain per year at the maximum application rate (between 150 and 250 in of rain per at the typical application rate). Therefore, there is potential for risk to RTE plant species in this watershed type with high amounts of precipitation. This scenario is unlikely on most public lands because of arid and semi-arid conditions.

Risk quotients for non-target aquatic plants impacted by surface runoff exceeded the plant LOC for nearly all pond scenarios. Acute RQs for non-target aquatic plants in the stream were also above the plant LOC of 1 in 33 of the 42 scenarios at the typical application rate. At the maximum application rate, elevated RQs occurred in 36 of the 42 scenarios. These results indicate the likelihood for acute impacts to aquatic plants in the stream.

Chronic RQs in the stream were generally below the plant LOC at the typical application rate, except in the base watershed with sandy soils and precipitation of more than 50 in per year and in the larger application areas (100 and 1,000 ac). Most chronic stream RQs were above the plant LOC when the maximum application rate was considered. The only scenarios below this LOC were the base watershed with sand, clay, or loam soils and less than 25 in of rain per year, the base watershed with clay-loam soil and 50 in of rain per year, and the 1 acre application area. These results indicate the likelihood for chronic impacts to aquatic plants in the stream under most conditions.

Fish and Aquatic Invertebrates

Acute toxicity RQs for fish and aquatic invertebrates were below the most conservative LOC of 0.05 for all stream scenarios and nearly all pond scenarios. Three acute toxicity RQs for fish in the pond were just over the most conservative LOC, but below the remaining two acute LOCs, with values of 0.052, 0.056, and 0.051. These results indicate that impacts from surface runoff are not likely to pose a risk to most aquatic species, but may pose a slight risk to RTE fish.

Chronic risk RQs for aquatic invertebrates in the pond and stream and fish in the stream were well below the LOC for chronic risk to RTE species (0.5), indicating that these scenarios are not likely to result in long-term risk to these receptors. However, chronic risk RQs for fish in the pond were above the LOC for chronic risk to RTE species in several scenarios. At the typical application rate, elevated RQs ranged from 0.51 in the base watershed with sandy soil and 50 in of precipitation per year to 1.69 in the same watershed with 25 in of precipitation per year. Only two of these RQs were elevated above the chronic risk LOC of 1. At the maximum application rate, RQs over the LOC for chronic risk to RTE species (0.5) occurred in 35 of 42 modeled scenarios. These results indicate the potential for negative chronic impacts to fish in downgradient ponds due to surface runoff, especially at the maximum application rate.

Piscivorous Birds

Risk quotients for the piscivorous bird were all well below the most conservative terrestrial animal LOC (0.1), indicating that this scenario is not likely to pose a risk to piscivorous birds.

Wind Erosion and Transport Off-site

Risk quotients for typical and RTE terrestrial plants in this scenario were all well below the plant LOC (1), indicating that wind erosion is not likely to pose a risk to non-target terrestrial plants.

Accidental Spill to Pond

Risk quotients for the spill scenario were 1.2 for fish, 0.66 for aquatic invertebrates, and 6,330 for non-target aquatic plants. Potential risk to fish, aquatic invertebrates, and non-target aquatic plants were indicated for the truck spills mixed for the maximum application rate.

Potential Risk to Salmonids from Indirect Effects

Qualitative Evaluation of Impacts to Prey

Risk quotients in excess of the acute LOCs for aquatic invertebrates were only observed for the accidental direct spray scenario. All other acute and chronic RQs from accidental spray, off-site drift, and surface runoff scenarios were below the associated LOCs. Because aquatic invertebrates are not predicted to be directly impacted by herbicide concentrations in the stream as a result of normal applications, salmonids are not likely to be indirectly affected by a reduction in prey.

Qualitative Evaluation of Impacts to Vegetative Cover

Aquatic plant RQs for accidental direct spray scenarios were above the plant LOC at both the typical and maximum .application rates. Elevated acute and chronic aquatic plant RQs (ranging from 1.01 to 10.7) were also observed as a result of off-site drift within 100 ft of the application area. Acute risk was observed for nearly all surface runoff scenarios. Chronic risk due to surface runoff was also predicted in most scenarios at the maximum application rate. At the typical application rate, minimal chronic risk was observed in the base watershed with sandy soils, and more significant risk was predicted when the application area was increased from 10 acres to 100 and 1,000 acres. These results indicate the potential for a reduction in cover and indirect impacts to salmonids as a consequence of multiple exposure pathways.

Risk quotients for terrestrial plants were elevated above the LOC for accidental direct spray scenarios at both the typical and maximum application rates, indicating the potential for a reduction in this plant community. Risk quotients above the plant LOC for typical terrestrial plants were also observed for all off-site drift scenarios modeled for bromacil. However, non-target terrestrial plant RQs in excess of the LOC, as a result of surface runoff, were only observed for the base watershed with clay soil and at least 100 in of rain per year. All other runoff scenarios predicted RQs less than 1. Therefore, in addition to the potential loss of aquatic vegetative cover, under most scenarios a reduction in riparian vegetation and loss of terrestrial vegetative cover to salmonids are likely results of accidental direct spray and off-site drift of bromacil.

Chlorsulfuron

Direct Spray

Terrestrial Wildlife

Risk quotients for terrestrial wildlife were all below the most conservative LOC of 0.1 (acute RTE species), indicating that direct spray impacts are not likely to pose a risk to terrestrial animals.

Non-target Plants – Terrestrial and Aquatic

As expected, because of the mode of action of herbicides, RQs for non-target terrestrial plants ranged from 746 to 6,667, and RQs for non-target aquatic plants ranged from 7.5 to 196. The lowest RQs were calculated for typical species at the typical application rate, and the highest RQs were calculated for RTE species at the maximum application rate. All of the RQs were above the plant LOC of 1, indicating that direct spray impacts pose a risk to plants in both aquatic and terrestrial environments.

Fish and Aquatic Invertebrates

RQs for fish and aquatic invertebrates were all below the most conservative LOC of 0.05 (acute RTE species), indicating that direct spray impacts are not likely to pose a risk to these aquatic receptors.

Off-Site Drift

Non-target Plants – Terrestrial and Aquatic

The majority of the RQs for non-target terrestrial plants affected by off-site drift to soil were above the plant LOC of 1. Only RQs based on off-site drift 900 ft from ground application with a low or a high boom were below the plant LOC. These results indicate the potential for risk to off-site non-target terrestrial plants due to drift.

The majority of the RQs for non-target aquatic plants affected by off-site drift were below the plant LOC of 1. However, chronic toxicity RQs above the LOC occurred with some aerial applications. Chronic toxicity RQs in the stream were elevated for off-site drift 100 ft from applications by plane and helicopter at the maximum application rate.

Fish and Aquatic Invertebrates

Acute toxicity RQs for fish and aquatic invertebrates were all below the most conservative LOC of 0.05

(acute RTE species). All chronic RQs were well below the LOC for chronic risk to RTE species (0.5). These results indicate that off-site drift of chlorsulfuron is not likely to pose acute or chronic risk to these aquatic species.

Piscivorous Birds

Risk quotients for the piscivorous bird were all well below the most conservative terrestrial animal LOC (0.1), indicating that this scenario is not likely to pose a risk to piscivorous birds.

Surface Runoff

Non-target Plants – Terrestrial and Aquatic

Risk quotients for non-target terrestrial plants affected by surface runoff to off-site soil were all below the plant LOC of 1, indicating that transport due to surface runoff is not likely to pose a risk to typical or RTE terrestrial plant species.

Acute RQs for non-target aquatic plants in streams impacted by surface runoff of herbicide were generally below the plant LOC of 1. However, there were some scenarios where values exceeded the plant LOC at the typical or maximum application rate. At both the typical and maximum application rates, elevated RQs were predicted in sandy watersheds with annual precipitation above 100 in. In addition, at the maximum application rate, elevated acute RQs were predicted in the clay watershed with at least 100 in of annual precipitation. These scenarios are unlikely to occur on public lands because of arid and semi-arid conditions. Chronic RQs for non-target aquatic plants in the stream impacted by runoff or overland flow of herbicide were all below the plant LOC of 1. Therefore, it is possible that in some locations aquatic plants in the stream would be at acute risk from surface runoff of chlorsulfuron, but this transport mechanism is not likely to pose a chronic risk to aquatic plant species in the stream.

Risk quotients exceeded the LOC for several pond scenarios at both typical and maximum application rates. Elevated acute RQs based on the typical application rate ranged from 1.11 to 11.8, as a result of surface runoff through sandy soil in the base watershed with annual precipitation above 50 inches, and clay watersheds with annual precipitation above 25 inches through loam watersheds with annual precipitation above 200 in, and through three variations of the base watershed with 50 in of rain per year (silt loam, silt, and clay loam soils). Elevated acute RQs ranging from 1.54 to 35.3 were predicted at the maximum application rate resulting from surface runoff through the same scenarios that generated elevated RQs at the typical application rate, as well as sandy watersheds with at least 25 inches of precipitation per year and loam watersheds with at least 100 inches of precipitation per year. Of the 42 scenarios modeled for the pond, acute RQs were elevated above the LOC for 16 scenarios at the typical application rate and 19 scenarios at the maximum application rate. Chronic RQs ranging from 1.1 to 4.4 were predicted due to surface runoff to the pond at the typical application rate, and chronic RQs ranging from 1.2 to 13.1 were predicted due to surface runoff at the maximum application rate. Of the 42 scenarios modeled, chronic RQs were elevated above the LOC for four scenarios with the typical application rate and twelve scenarios with the maximum application rate. This suggests that aquatic plants in the pond are at acute and chronic risk from surface runoff of chlorsulfuron resulting from most application scenarios.

Fish and Aquatic Invertebrates

Acute toxicity RQs for fish and aquatic invertebrates were all below the most conservative LOC of 0.05 (acute RTE species) for all pond and stream scenarios, and chronic toxicity RQs were well below the LOC for chronic risk to RTE species (0.5), indicating that these scenarios are not likely to result in long-term risk to aquatic animals in streams or ponds.

Piscivorous Birds

Risk quotients for the piscivorous bird were all well below the most conservative terrestrial animal LOC (0.1), indicating that this scenario is not likely to pose a risk to piscivorous birds.

Wind Erosion and Transport Off-site

Risk quotients for typical and RTE terrestrial plants were all well below the plant LOC (1), indicating that wind erosion is not likely to pose a risk to non-target terrestrial plants.

Accidental Spill to Pond

Risk quotients for the spill scenarios resulted in elevated RQs only for non-target aquatic plants, with fish and aquatic invertebrates generating values below the identified LOC. Potential risk to non-target aquatic

plants was indicated for both the truck and helicopter spills mixed for the maximum application rate.

Potential Risk to Salmonids from Indirect Effects

Qualitative Evaluation of Impacts to Prey

No RQs in excess of the appropriate acute or chronic LOCs were observed for aquatic invertebrates in any of the stream scenarios. Because aquatic invertebrates are not predicted to be directly impacted by herbicide concentrations in the stream, salmonids are not likely to be indirectly affected by a reduction in prey.

Qualitative Evaluation of Impacts to Vegetative Cover

Aquatic plant RQs for accidental direct spray scenarios were above the plant LOC at both the typical and maximum application rates, indicating the potential for a reduction in the aquatic plant community. In the unlikely event that a stream was accidentally sprayed, there would be the potential for indirect impacts to salmonids caused by a reduction in available cover.

Minimal elevated aquatic plant chronic RQs (RQs of 1.07 and 1.23) were also observed as a result of off-site drift from selected aerial applications of chlorsulfuron, indicating the potential for a reduction in cover overtime. No elevated aquatic plant acute RQs were predicted due to drift. No RQs in excess of the LOC were observed for aquatic plant species in the stream for any of the surface runoff scenarios.

Risk quotients for terrestrial plants were elevated above the LOC for accidental direct spray scenarios at both the typical and maximum application rates, indicating the potential for a reduction in this plant community. In addition, RQs for typical terrestrial plants were observed above the plant LOC (ranging from 1.52 to 21.4) for nearly all scenarios as a result of off-site drift. No RQs in excess of the LOC were observed for terrestrial plant species for any of the surface runoff scenarios. These results indicate the potential for a reduction in riparian cover under selected conditions.

Diflufenzopyr

Direct Spray

Terrestrial Wildlife

Risk quotients for terrestrial wildlife were all below the most conservative LOC of 0.1 (acute RTE species), indicating that direct spray impacts are not likely to pose a risk to terrestrial animals.

Non-target Plants – Terrestrial and Aquatic

Risk quotients for non-target terrestrial plants ranged from 93.8 to 333, and RQs for non-target aquatic plants ranged from 0.084 to 7.19. As expected because of the mode of action of herbicides, all of the terrestrial plant RQs were above the plant LOC of 1, indicating that direct spray impacts may pose a risk to these receptors. Aquatic plant RQs were below the plant LOC in all acute scenarios and above the plant LOC in all chronic scenarios, indicating the potential for long-term harm to these receptors.

Fish and Aquatic Invertebrates

All acute and chronic toxicity RQs for fish and aquatic invertebrates were below the most conservative LOC (0.05 for acute risk RTE species; 0.5 for chronic risk RTE species). These results indicate that impacts from direct spray are generally not likely to pose acute or chronic risk to these aquatic species.

Off-site Drift

Non-target Plants – Terrestrial and Aquatic

The majority of the RQs for non-target terrestrial plants affected by off-site drift to soils were below the plant LOC of 1. However, RQs did exceed the LOC (ranging from 1.13 to 7.0) for several application scenarios. Off-site drift 25 ft from ground application with a low or high boom at the typical and maximum application rates resulted in RQs above the LOC for both typical and RTE species. Additional risk was also predicted for RTE species within 100 ft of a low boom application at the typical application rate and within 100 ft of a high boom application at the typical and maximum application rates. Therefore, there is potential risk to typical terrestrial plant species from off-site drift of diflufenzopyr within 25 ft of the application, and there is risk to RTE terrestrial plant species from herbicide drift within 100 ft of the application area.

All RQs for non-target aquatic plants affected by off-site drift were below the plant LOC of 1, indicating this transport mechanism is not likely to impact these receptors.

Fish and Aquatic Invertebrates

Acute toxicity RQs for fish and aquatic invertebrates were all below the most conservative LOC of 0.05 (acute RTE species), and all chronic RQs were well below the LOC for chronic risk to RTE species (0.5). These results indicate that impacts from off-site drift are not likely to pose acute or chronic risk to these aquatic species.

Piscivorous Birds

Risk quotients for piscivorous birds were all well below the most conservative terrestrial animal LOC (0.1), indicating that this scenario is not likely to pose a risk to these species.

Surface Runoff

Non-target Plants – Terrestrial and Aquatic

Risk quotients for typical non-target terrestrial plant species affected by surface runoff to off-site soil were all below the plant LOC of 1, indicating that transport due to surface runoff is not likely to pose a risk to these receptors. Most RQs for RTE non-target terrestrial plant species were also below the plant LOC of 1; however, a couple scenarios did result in elevated RQs at the typical or maximum application rate. These scenarios were surface runoff in the base watershed with clay soils and more than 25 inches of precipitation per year and runoff in the base watershed with silt-loam, silt, or clay-loam soils and 50 inches of precipitation per year. This indicates the potential for risk to RTE plant species in selected watersheds at the typical and maximum application rates with greater than 25 inches of precipitation per year.

Acute and chronic RQs for non-target aquatic plants in the pond and streams impacted by overland flow of diflufenzopyr were all below the plant LOC of 1. In addition, acute RQs for non-target aquatic plants in the pond were also below the plant LOC. These results indicate that this transport mechanism is not likely to pose a risk to aquatic plant species under these conditions.

Fish and Aquatic Invertebrates

Acute and chronic toxicity RQs for fish and aquatic invertebrates in ponds and streams were all below the most conservative LOCs (0.05 and 0.5, respectively), indicating that impacts from surface runoff are not likely to pose a risk to these aquatic species.

Piscivorous Birds

Risk quotients for piscivorous birds were all well below the most conservative terrestrial animal LOC (0.1), indicating that this scenario is not likely to pose a risk to piscivorous birds.

Wind Erosion and Transport Off-site

Risk quotients for typical and RTE terrestrial plants were all well below the plant LOC (1), indicating that wind erosion is not likely to pose a risk to non-target terrestrial plants.

Accidental Spill to Pond

Risk quotients for the spill scenario ranged from 0.00338 for fish and 0.0239 for aquatic invertebrates to 3.59 for non-target aquatic plants. Potential risk to non-target aquatic plants was indicated for the truck spill with diflufenzopyr mixed for the maximum application rate.

Potential Risk to Salmonids from Indirect Effects

Qualitative Evaluation of Impacts to Prey

No RQs in excess of the appropriate acute or chronic LOCs were observed for aquatic invertebrates in any of the stream scenarios. Because aquatic invertebrates are not predicted to be directly impacted by herbicide concentrations in the stream, salmonids are not likely to be indirectly affected by a reduction in prey.

Qualitative Evaluation of Impacts to Vegetative Cover

Chronic aquatic plant RQs for accidental direct spray scenarios were above the plant LOC at both the typical and maximum application rates, indicating the potential for a reduction in the aquatic plant community over time. Therefore, in the unlikely event that a stream is accidentally sprayed, there would be the potential for indirect impacts to salmonids caused by a reduction in available cover.

No RQs in excess of the LOC were observed for stream aquatic plant species for any of the off-site drift or surface runoff scenarios.

Risk quotients for terrestrial plants were elevated above the LOC for accidental direct spray scenarios at both the typical and maximum application rates, indicating the potential for a reduction in this plant community.

Risk quotients for typical terrestrial plants were also observed above the plant LOC (ranging from 1.13 to 7.00) as a result of off-site drift. Off-site drift 25 ft from ground application with a low or high boom resulted in RQs above the LOC at the typical and maximum application rates for both typical and RTE species. Additional risk was also predicted for RTE species within 100 ft of a low-boom application at the typical application rate and within 100 ft of a high-boom application at the typical and maximum application rates. These results indicate the potential for a reduction in riparian cover under selected conditions.

No RQs in excess of the LOC were observed for terrestrial plant species for any of the surface runoff scenarios.

Diquat

Direct Spray

Terrestrial Wildlife

Acute RQs for terrestrial wildlife were above the most conservative LOC of 0.1 (acute RTE species) for several scenarios. Accidental direct spray of the pollinating insect resulted in elevated RQs at both the typical and maximum application rates. Risk was also predicted for the pollinating insect as a result of indirect contact with foliage accidentally sprayed at the maximum application rate. No risks to the small mammal were predicted due to direct spray or indirect contact with foliage.

Acute exposure RQs were elevated above the associated LOC (0.1; acute risk RTE species) for two scenarios using the typical application rate (large mammalian herbivore and small avian insectivore) and for five scenarios at the maximum application rate (large and small mammalian herbivores, large avian herbivore, large mammalian carnivore, and small avian insectivore).

Chronic exposure RQs were elevated above the associated LOC (1.0; risk RTE species) for three scenarios using the typical application rate (large and small mammalian herbivore and large avian herbivore) and for four scenarios at the maximum application rate (large mammalian and avian herbivores, small mammalian herbivore, and small avian insectivore).

This evaluation indicates that accidental direct spray impacts may pose a risk to insects, birds, and wildlife, primarily when the maximum application rate is used.

Non-target Plants – Terrestrial and Aquatic

As expected, because of the mode of action of herbicides, RQs for non-target terrestrial and aquatic plants impacted by direct spray were above the plant LOC of 1 for all modeled scenarios. Risk quotients for direct spray of non-target terrestrial plants ranged from 213 to 2,500. Risk quotients for non-target aquatic plants impacted by routine application to the pond or accidental direct spray of the stream ranged from 149 to 7,472. Therefore, direct spray impacts pose a risk to plants in both aquatic and terrestrial environments.

Fish and Aquatic Invertebrates

Acute and chronic toxicity RQs for fish and aquatic invertebrates in the pond and stream were all above the most conservative associated LOCs (0.05 for acute risk RTE species; 0.5 for chronic risk RTE species).

These results indicate there is potential risk to aquatic species, especially RTE species, in a pond or stream sprayed with diquat.

Piscivorous Birds

Risk quotients for piscivorous birds were all well below the most conservative terrestrial animal LOC (0.1), indicating that diquat application is not likely to pose a risk to piscivorous birds.

Off-site Drift to Terrestrial Plants

Risk quotients for both typical and RTE terrestrial plant species were elevated over the plant LOC of 1 for several scenarios. At the typical application rate, RQs were elevated for typical and RTE plant species within 900 ft of the aerial application of the herbicide (helicopter and fixed-wing plane) and within 100 ft of ground applications (high boom). At the maximum application rate, RQs for typical plant species were elevated for all aerial applications and within 100 ft of

ground applications (low- and high-booms). Risk quotients for RTE plant species were elevated for all evaluated herbicide applications using the maximum rate, and for all but two scenarios at the typical application rate (high- and low-boom ground applications with 900 foot buffers). These results indicate that potential risk to non-target terrestrial plants exists due to off-site drift during application of this aquatic herbicide.

Accidental Spill to Pond

Potential risks to fish, aquatic invertebrates, and non-target aquatic plants were indicated for the truck and helicopter spills mixed for the maximum application rate. Risk quotients for the truck spill scenario were 19.1 for fish, 102 for aquatic invertebrates, and 19,129 for non-target aquatic plants. Risk quotients for the helicopter spill scenario were higher at 67 for fish, 359 for aquatic invertebrates, and 66,952 for non-target aquatic plants.

Potential Risk to Salmonids from Indirect Effects

Qualitative Evaluation of Impacts to Prey

Risk quotients in excess of the acute LOCs for aquatic invertebrates were observed for the accidental direct spray scenario at both the typical and maximum application rates. This conservative evaluation predicts that fish and aquatic invertebrates would be directly impacted by herbicide concentrations in the stream. Accordingly, their availability as prey item populations may be impacted, and this may result in an indirect effect on salmonids.

Qualitative Evaluation of Impacts to Vegetative Cover

Aquatic plant RQs for accidental direct spray scenarios were above the plant LOC at both the typical and maximum application rates. Therefore, there is the potential for indirect impacts to salmonids due to a reduction in available cover in the unlikely event that a stream is accidentally sprayed.

In addition, RQs for terrestrial plants were elevated above the LOC for accidental direct spray scenarios at both the typical and maximum application rates, indicating the potential for a reduction in this plant community and potential indirect impacts to salmonids due to a loss of riparian cover.

Diuron

Direct Spray

Terrestrial Wildlife

In general, most acute RQs for terrestrial wildlife were below the most conservative LOC of 0.1 (acute RTE species). However, direct spray of the pollinating insect resulted in elevated RQs at both the typical and maximum application rates. In addition, at the maximum application rate, risk was also predicted for the pollinating insect from indirect contact with foliage impacted by direct spray.

Risk quotients for acute ingestion scenarios were below the most conservative LOC (0.1; acute risk RTE species) when herbicide is applied at the typical rate, but above the LOC in all cases at the maximum application rate.

Risk quotients for chronic ingestion scenarios were above the associated LOC of 1.0 for three receptors (the small and large mammalian herbivores and the large mammalian carnivore) when herbicide is applied at the typical or maximum application rate. At the maximum application rate, elevated RQs were also predicted for the small mammalian herbivore and the large avian herbivore.

This evaluation indicates that direct spray impacts may pose a risk to insects, birds, and mammals, primarily when the maximum application rate is used.

Non-target Plants – Terrestrial and Aquatic

Risk quotients for non-target terrestrial plants ranged from 75 to 20,000, and RQs for non-target aquatic plants ranged from 517 to 25,474. All of the RQs were above the plant LOC of 1.0, indicating that, as expected, direct spray impacts pose a risk to plants in both aquatic and terrestrial environments.

Fish and Aquatic Invertebrates

Acute and chronic toxicity RQs for fish and aquatic invertebrates in the pond and stream were above the most conservative LOCs (0.05 for acute risk RTE species; 1.0 for chronic risk), indicating that direct spray impacts may pose a risk to these aquatic species.

Off-site Drift

Non-target Plants – Terrestrial and Aquatic

Many of the RQs for non-target terrestrial plants affected by off-site drift to off-site soils were above the plant LOC of 1.0. For typical terrestrial plant species, elevated RQs were predicted at the typical application rate 25 ft from application with a high boom and at the maximum application rate within 100 ft from application with a low or high boom. Elevated RQs were predicted for RTE terrestrial plant species under all off-site drift scenarios. These results indicate that terrestrial plants, particularly RTE species, located near applications areas may be impacted by herbicide drift.

The majority of the RQs for non-target aquatic plants affected by off-site drift were above the plant LOC of 1.0. The only scenario that did not consistently predict elevated RQs was off-site drift 900 ft from the application area. More elevated RQs were predicted with application using the high boom. These results indicate that off-site drift may impact aquatic plants in waterbodies adjacent to application areas.

Fish and Aquatic Invertebrates

Acute toxicity RQs for fish were below the most conservative LOC of 0.05 (acute RTE species) for all scenarios except one (off-site drift to the stream 25 ft from the maximum application with a high boom). Acute toxicity RQs for aquatic invertebrates were generally also below the most conservative LOC of 0.05 (acute RTE species). However, off-site drift to the pond and stream within 25 ft of a low-boom application or within 100 ft of a high-boom application at the maximum application rate predicted elevated RQs for aquatic invertebrates. Off-site drift within 25 ft of a high-boom application at the typical application rate also predicted a slightly elevated RQ (0.077) in the stream. These results indicate the potential for acute risk to fish and invertebrates due to off-site drift under selected application conditions.

Most chronic RQs were well below the LOC for chronic risk to RTE species (0.5). However, application at the maximum application rate resulted in elevated RQs for one aquatic invertebrate scenario (in the stream 25 ft from the high boom application) and three fish scenarios (in the pond 25 ft from the high-boom application and in the stream 25 ft from the low- and high-boom applications). For fish, the only the scenario with an RQ above the chronic LOC of 1.0 was for the stream 25 ft from application at the maximum rate with a high boom. These results indicate minimal potential for chronic risk, except within 25 ft of the application area at the maximum application rate.

Piscivorous Birds

Risk quotients for piscivorous birds were all well below the most conservative terrestrial animal LOC (0.1), indicating that this scenario is not likely to pose a risk to piscivorous birds.

Surface Runoff

Non-target Plants – Terrestrial and Aquatic

Risk quotients for typical non-target terrestrial plant species affected by surface runoff to off-site soil were all below the plant LOC of 1.0, indicating that transport due to surface runoff is not likely to pose a risk to these receptors. Most RQs for RTE non-target terrestrial plant species were also below the plant LOC of 1.0; however, several scenarios did result in elevated RQs. At the typical application rate, RQs for the base watershed with clay soils and between 100 and 250 inches of rain per year (250 inches per year was the maximum rainfall modeled) ranged from 1.0 to 2.85. At the maximum application rate, RQs were elevated above 1.0 for the base watershed with clay soils and at least 50 inches of rain per year, for the base watershed with loam soils and at least 200 inches of rain per year, and for the base watershed with clay-loam soil and 50 inches of rain per year (no other rainfall amounts were modeled for this scenario). This indicates the potential for risk to RTE plant species in certain watersheds (with precipitation greater than 50 inches) at the typical or maximum application rates (these scenarios are unlikely on many public lands because of arid and semi-arid conditions).

Acute and chronic RQs for non-target aquatic plants impacted by herbicide runoff exceeded the plant LOC for nearly all pond scenarios modeled at both the typical and maximum application rates.

Acute RQs for non-target aquatic plants in the stream were also generally above the plant LOC of 1.0. At the typical application rate, elevated RQs occurred in 35 of the 42 scenarios. At the maximum application rate, elevated RQs occurred in 37 of the 42 scenarios. These results indicate the high potential for acute impacts to aquatic plants in the stream.

Chronic RQs in the stream at the typical application rate were above the plant LOC for several scenarios (base watershed with sandy soils and precipitation of more than 25 inches per year; base watershed with clay or loam soils and precipitation of more than 100 inches per year; and 100 and 1,000 ac application areas).

Most chronic stream RQs were above the plant LOC when the maximum application rate was considered. The only scenarios below this LOC were the base application watershed with sandy soils and less than 10 inches of rain per year; the base application watershed with clay or loam soil and less than 25 inches of rain per year; the 1 acre application area; and the base watershed with silt soil and 50 inches of rain per year. These results indicate the potential for chronic impacts to aquatic plants in the stream under most conditions at the maximum application rate.

Fish and Aquatic Invertebrates

Acute toxicity RQs for fish and aquatic invertebrates were above the most conservative LOC of 0.05 (acute RTE species) for nearly all pond scenarios. At the typical application rate, RQs were elevated above 0.05 for fish in 35 of 42 scenarios, and for aquatic invertebrates in 36 of 42 scenarios. At the maximum application rate, this increased to 36 and 38 of 42 scenarios for fish and aquatic invertebrates, respectively. Acute RQs for aquatic invertebrates in the stream were greater than the LOC of 0.05 for most scenarios at the maximum application rate (35 of 42 scenarios) and for high precipitation scenarios at the typical application rate (18 of 42 scenarios). Acute RQs for fish in the stream were greater than the LOC for high precipitation scenarios at the maximum application rate (16 of 42 scenarios) and for high precipitation scenarios in clay soils at the typical application rate (3 of 42 scenarios). This suggests that diuron poses substantial acute risks to aquatic animals in ponds and limited acute risks to aquatic stream animals (i.e., at the maximum application rate and in wet watersheds).

Chronic toxicity RQs in the stream were well below the LOC for chronic risk to RTE species (0.5), indicating that these scenarios are not likely to result in long-term risk to fish or aquatic invertebrates. However, chronic RQs for fish and aquatic invertebrates were elevated above this LOC in several pond scenarios. At the maximum application rate, RQs were elevated above 0.5 for fish in 36 of 42 scenarios, and for aquatic invertebrates in 33 of 42 scenarios. At the typical application rate, RQs were elevated above 0.5 for fish in 30 of 42 scenarios, and for aquatic invertebrates in 10 of 42 scenarios. At the typical application rate, only 10 of the fish RQs and 3 of the aquatic invertebrate RQs were above the chronic LOC of 1 for typical species, indicating significantly less risk to non-RTE species. These results indicate the potential for risk to fish and aquatic invertebrates in the pond, especially RTE species, as a result of surface runoff.

Piscivorous Birds

Risk quotients for the piscivorous bird exposed to surface runoff of diuron were all well below the most conservative terrestrial animal LOC (0.1), indicating that this scenario is not likely to pose a risk to piscivorous birds.

Wind Erosion and Transport Off-site

Risk quotients for typical and RTE terrestrial plants were all well below the plant LOC (1), indicating that wind erosion is not likely to pose a risk to non-target terrestrial plants.

Accidental Spill to Pond

Risk quotients for the spill scenario were 101 for fish, 448 for aquatic invertebrates, and 55,180 for non-target aquatic plants. Therefore, there is the potential for risk to fish, aquatic invertebrates, and non-target aquatic plants under the scenario of a truck spill with diuron mixed for the maximum application rate.

Potential Risk to Salmonids from Indirect Effects

Qualitative Evaluation of Impacts to Prey

Risk quotients in excess of the acute and chronic LOCs for aquatic invertebrates were observed for the accidental direct spray scenario.

The off-site drift scenarios predicted elevated RQs for aquatic invertebrates (mostly RTE species) under selected conditions, primarily within 100 ft of the application area at the maximum application rate (two scenarios predicted acute risk to aquatic invertebrates in the stream at the typical application rate and for a buffer of more than 100 and less than 900 ft). All chronic RQs for aquatic invertebrates in the stream impacted by surface runoff were below the associated LOCs. Acute RQs for these surface runoff scenarios were elevated above the most conservative LOC for

several scenarios; most significantly for aquatic invertebrates at the maximum application rate.

Because fish may be directly impacted by herbicide concentrations in the stream as a result of normal applications, their availability as prey item populations may be impacted, and there may be an indirect effect on salmonids.

Qualitative Evaluation of Impacts to Vegetative Cover

Aquatic plant RQs for accidental direct spray scenarios were above the plant LOC at both the typical and maximum application rates, indicating the potential for a reduction in the aquatic plant community. Therefore there is the potential for indirect impacts to salmonids due to a reduction in available cover in the unlikely event that a stream is accidentally sprayed.

Elevated aquatic plant RQs were also observed in the stream scenario as a result of off-site drift of the ground application of the herbicide more than 100 and less than 900 ft from the stream, indicating the potential for a reduction in cover, most significantly at the maximum application rate (chronic risk to aquatic plants are also predicted with greater than a 900-foot buffer at the maximum application rate). Elevated RQs were also predicted for many of the surface runoff scenarios. These results indicate there is the potential for indirect impacts to salmonids due to reduction in available cover due to off-site drift and surface runoff of the applied herbicide.

Risk quotients for typical and RTE terrestrial plants were elevated above the LOC for accidental direct spray scenarios at both the typical and maximum application rates, indicating the potential for a reduction in this plant community. However, as discussed above, this scenario is unlikely to occur as a result of BLM practices and represents a worst-case scenario.

Risk quotients for typical terrestrial plants were also observed above the plant LOC (ranging from 1.1 to 5.19) as a result of off-site drift from the ground application of the herbicide. At the typical application rate, risk was predicted at least 25 ft and less than 100 ft from the application area, and at the maximum application rate, risk was predicted at least 100 ft and less than 900 ft from the application area. Elevated RQs for RTE species were also observed for all modeled application scenarios. These results indicate the potential for a reduction in riparian cover and indirect effects to salmonids due to off-site drift under selected conditions.

No RQs in excess of the LOC were observed for typical terrestrial plant species for any of the surface runoff scenarios. Elevated RQs were predicted for RTE terrestrial plant species under selected surface runoff conditions, primarily in clay or loam soils at high precipitation levels. These results indicate the limited potential for a reduction in riparian cover due to surface runoff, primarily when RTE plant species are present.

Fluridone

Direct Spray

Terrestrial Wildlife

Acute RQs for terrestrial animals were below the most conservative LOC of 0.1 (acute RTE species) for all scenarios. At the maximum application rate, the small mammalian herbivore had an RQ of 2.22, all other RQs were well below the LOC of 1. These results indicate that accidental direct spray impacts are not likely to pose a risk to insects, birds, or mammals.

Non-target Plants – Terrestrial and Aquatic

No toxicity data were identified for non-target terrestrial plant species; therefore, a quantitative evaluation is not possible. However, the ecological incident report described in Section 2.3 suggests that impacts to terrestrial plants are possible due to unintended contact with fluridone. In the manufacturer's user's guide for the Sonar® aquatic herbicide (Eli Lilly and Company 2003), grasses and some sedges are considered to be "sensitive" or "intermediate" in their tolerance to the herbicide, while rushes tend to be "intermediate" to "tolerant". Shoreline plants, such as willow and cypress, were considered "tolerant," while the tolerance of members of the evening primrose and acanthus families was classified as "intermediate." No concentrations were associated with these qualitative statements. It is the more tolerant shoreline plants that are more likely to come in contact with fluridone during normal pond applications.

For aquatic plants, all of the RQs were below the plant LOC of 1, indicating that direct spray impacts are not predicted to pose a risk to aquatic plants in the stream or the pond.

Fish and Aquatic Invertebrates

Normal application of fluridone within a pond resulted in one RQ elevated over the associated LOC. The acute RQ for aquatic invertebrates in the pond impacted by the maximum application rate of fluridone was 0.11, just above the LOC for acute risk to RTE species (0.05).

Accidental direct spray of fluridone over the stream results in elevated acute and chronic RQs. Elevated acute RQs were 0.17 for fish at the maximum application rate, and 0.065 and 0.56 for invertebrates at the typical and maximum application rates, respectively. These RQs were all above the acute risk to RTE species LOC, but below or nearly consistent with the acute high risk LOC. Elevated chronic RQs were 1.5 for fish and 1.8 for invertebrates at the maximum application rate. These RQs were above the LOC for chronic risk to RTE species (0.5) and the LOC for chronic risk (1).

These results indicate there is potential for risk to aquatic species, especially RTE species, in a stream sprayed with fluridone. However, this scenario is not likely to occur as fluridone is reserved for use in ponds.

Piscivorous Birds

Risk quotients for the piscivorous bird were all well below the most conservative terrestrial animal LOC (0.1), indicating that the direct spray scenario is not likely to pose a risk to piscivorous birds.

Off-site Drift to Non-target Terrestrial Plants

As described previously, no toxicity data were identified for non-target terrestrial plant species; therefore, a quantitative evaluation of this scenario is not possible. However, impacts to terrestrial plants are possible due to unintended contact with fluridone.

It may be noted that the concentrations of fluridone predicted due to off-site drift are significantly lower than those modeled for accidental direct spray of fluridone on near-shore terrestrial plants. This comparison indicates that the maximum deposition (100 ft from aerial applications) was only 23.8% of the typical application rate and only 0.87% of the maximum application rate. On average, off-site drift modeled using the typical application rate was less than 10% of the typical application rate used in the direct spray scenario. Off-site drift modeled using the maximum application rate was less than 1% of the maximum application rate used in the direct spray scenario. This indicates the reduction in deposition and associated risks that occur with off-site drift relative to direct accidental spray.

Accidental Spill to Pond

Risk quotients for the truck spill scenario were 1.10 for fish, 3.58 for aquatic invertebrates, and 1.56 for non-target aquatic plants. Risk quotients for the helicopter spill scenario were slightly higher at 3.83, 12.6, and 5.44 for fish, aquatic invertebrates, and non-target aquatic plants, respectively. Therefore, potential risks to fish, aquatic invertebrates, and non-target aquatic plants are indicated for the unlikely events of truck and helicopter spills mixed for the maximum application rate.

Potential Risk to Salmonids from Indirect Effects

Qualitative Evaluation of Impacts to Prey

Risk quotients in excess of the acute LOCs for aquatic invertebrates were observed for the accidental direct spray scenario. This conservative evaluation predicts that aquatic invertebrates may be directly impacted by herbicide concentrations in the stream. Accordingly, their availability as prey item populations may be impacted, and there may be an indirect effect on salmonids.

Qualitative Evaluation of Impacts to Vegetative Cover

Aquatic plant RQs for accidental direct spray scenarios were below the plant LOC at both the typical and maximum application rates, indicating that impacts to the aquatic plant community are not predicted. This evaluation indicates that indirect impacts to salmonids due to a reduction in available cover are unlikely.

It is uncertain whether or not a reduction in riparian cover is likely, but a review of incident reports and the manufacturer's user's guide indicate that shoreline plant species are generally tolerant of fluridone exposures.

Imazapic

Direct Spray

Terrestrial Wildlife

Risk quotients for terrestrial wildlife were all below the most conservative LOC of 0.1 (acute RTE species), indicating that direct spray impacts are not likely to pose a risk to terrestrial animals.

Non-target Plants – Terrestrial and Aquatic

As expected, because of the mode of action of herbicides, RQs for non-target terrestrial plants ranged from 3.1 to 23.8, and RQs for non-target aquatic plants ranged from 0.82 to 41.0. The lowest RQs were calculated for typical species at the typical application rate, and the highest RQs were calculated for RTE species impacted at the maximum application rate. All of the RQs were above the plant LOC of 1, indicating that direct spray impacts pose a risk to plants in both aquatic and terrestrial environments. The only possible exception is the accidental direct spray of the pond at the typical application rate.

Fish and Aquatic Invertebrates

Acute toxicity RQs for fish and aquatic invertebrates were below the most conservative LOC of 0.05 (acute RTE species), indicating that direct spray impacts are not likely to pose a risk to these aquatic species. All chronic RQs were well below the LOC for chronic risk to RTE species (0.5). These results indicate that impacts from direct spray are not likely to pose acute or chronic risk to fish and aquatic invertebrates.

Off-site Drift

Non-target Plants – Terrestrial and Aquatic

The majority of the RQs for non-target terrestrial plants affected by off-site drift to soil were below the plant LOC of 1. However, RQs for several aerial application scenarios did exceed the LOC, with RQs between 1.06 and 6.98. Off-site drift 100 ft from aerial application by plane or helicopter over forested or non-forested lands consistently resulted in an RQ above the LOC at the maximum application rate. In addition, off-site drift 300 ft from the aerial application by a plane over forested land also predicted an elevated RQ at the maximum application rate. Risk at the typical application rate was only predicted for RTE species as a result of drift 100 ft from the aerial application by a plane over forested lands. The predicted RQ of 1.06 was only slightly over the LOC, indicating that use of the typical application rate is not likely to result in risk to most non-target terrestrial species.

The majority of the RQs for non-target aquatic plants affected by off-site drift were below the plant LOC of 1. However, as with impacts to terrestrial plants, RQs above the LOC occurred with some aerial applications resulting in RQs between 1.07 and 2.36. Off-site drift 100 ft from the aerial application by a plane over forested lands consistently resulted in acute and chronic RQs above the LOC at the maximum application rate in the pond and the stream. Off-site drift 100 ft from the aerial application by a helicopter over forested land also predicted an elevated chronic RQ in the stream when applied at the maximum application rate. No elevated RQs were predicted at the typical application rate. Slightly more elevated risks were predicted in the stream than the pond.

Fish and Aquatic Invertebrates

Acute toxicity RQs for fish and aquatic invertebrates were all below the most conservative LOC of 0.05 (acute RTE species). All chronic RQs were well below the LOC for chronic risk to RTE species (0.5). These results indicate that impacts from off-site drift are not likely to pose acute or chronic risk to these aquatic species.

Piscivorous Birds

Risk quotients for the piscivorous bird were all well below the most conservative terrestrial animal LOC (0.1), indicating that off-site drift is not likely to pose a risk to piscivorous birds.

Surface Runoff

Minimal acute risk to non-target aquatic plants in the pond may occur when herbicides are applied at the maximum rate in watersheds with sandy soils and precipitation between 50 and 150 inches per year (RQs were just above 1); chronic risks to non-target aquatic plants in the pond may occur in watersheds with sandy soil and annual precipitation of 25 inches or greater. No risks were predicted for non-target terrestrial plants, non-target aquatic plants in the stream, fish, aquatic invertebrates, or piscivorous birds.

Non-target Plants – Terrestrial and Aquatic

Risk quotients for non-target terrestrial plants affected by surface runoff to off-site soil were all below the plant LOC of 1, indicating that transport due to surface runoff is not likely to pose a risk to typical or RTE terrestrial plant species.

Most RQs for non-target aquatic plants in streams impacted by surface runoff of herbicide were below the plant LOC of 1. The one exception was an acute RQ of 1.03 (just above the LOC), when imazapic is applied at the maximum rate in a watershed with clay soils and at least 250 inches of precipitation per year. However, this is a minimal exceedance; transport due to surface runoff is not likely to pose a risk to aquatic plants species in streams.

Risk quotients exceeded the LOC for several pond scenarios at the maximum application rate. Acute RQs greater than the LOC were predicted at the maximum application rate in the base watershed with sandy soils and at least 25 inches of precipitation per year (RQs ranged up to 4.34), in clay and clay/loam watersheds with at least 50 inches of precipitation per year (RQs ranged up to 7.51), and in loam watersheds with at least 100 inches of precipitation per year (RQs ranged up to 1.97). Acute RQs greater than the LOC were predicted at the typical application rate in watersheds with clay soils and at least 150 inches of precipitation per year (RQs ranged up to 1.72). Chronic RQs were predicted in the base watershed with sandy soil and annual precipitation greater than 25 inches.

Fish and Aquatic Invertebrates

Acute toxicity RQs for fish and aquatic invertebrates were all below the most conservative LOC of 0.05 (acute RTE species) for all pond and stream scenarios, indicating that impacts from surface runoff are not likely to pose a risk to these aquatic species.

Chronic toxicity RQs were well below the LOC for chronic risk to RTE species (0.5), indicating that these scenarios are not likely to result in long-term risk to aquatic animals in streams or ponds.

Piscivorous Birds

Risk quotients for the piscivorous bird were all well below the most conservative terrestrial animal LOC (0.1), indicating that surface runoff is not likely to pose a risk to piscivorous birds.

Wind Erosion and Transport Off-site

Risk quotients for typical and RTE terrestrial plants were all well below the plant LOC (1), indicating that wind erosion is not likely to pose a risk to non-target terrestrial plants.

Accidental Spill to Pond

Risk quotients for the spill scenarios ranged from 0.00681 for fish and aquatic invertebrates to 564 for non-target aquatic plants. Potential risk to non-target aquatic plants was indicated for both the truck and helicopter spills mixed for the maximum application rate.

Potential Risk to Salmonids from Indirect Effects

Qualitative Evaluation of Impacts to Prey

No RQs in excess of the appropriate acute or chronic LOCs were observed for aquatic invertebrates in any of the stream scenarios. Because aquatic invertebrates are not predicted to be directly impacted by herbicide concentrations in the stream, salmonids are not likely to be indirectly affected by a reduction in prey.

Qualitative Evaluation of Impacts to Vegetative Cover

Aquatic plant RQs for accidental direct spray scenarios were above the plant LOC at both the typical and maximum application rates, indicating the potential for a reduction in the aquatic plant community. Therefore, in the unlikely event that a stream is accidentally sprayed, there would be the potential for indirect impacts to salmonids caused by a reduction in available cover.

Slightly elevated aquatic plant RQs (ranging from 1.45 to 2.6) were also observed as a result of off-site drift 100 ft from the aerial application of imazapic, indicating the potential for a reduction in cover. One slightly elevated acute RQ (1.03) was predicted for aquatic plant species in streams impacted from surface runoff in the base watershed with clay soil and annual precipitation of 250 inches. No other elevated acute or chronic RQs were observed for any other surface runoff scenarios.

Risk quotients for terrestrial plants were elevated above the LOC for accidental direct spray scenarios at both the typical and maximum application rates,

indicating the potential for a reduction in this plant community.

Risk quotients for typical terrestrial plants were also observed above the plant LOC (ranging from 1.29 to 5.58) as a result of off-site drift from aerial application at the maximum rate. Off-site drift 100 ft from the application area resulted in risk when imazapic was applied from a helicopter or plane over forested and non-forested lands. Potential risk was also indicated 300 ft from the application area when applied by a plane over a forest. Elevated RQs for RTE species were also observed for the same application scenarios. These results also indicate the potential for a reduction in riparian cover under selected conditions.

Overdrive®

Direct Spray

Terrestrial Wildlife

Risk quotients for terrestrial wildlife were all below the most conservative LOC of 0.1 (acute RTE species), indicating that direct spray impacts are not likely to pose a risk to terrestrial animals. Risk quotients for chronic ingestion scenarios were below the associated LOC of 1 for all scenarios, except the ingestion of contaminated food items by the large mammalian herbivore. The scenario predicted elevated RQs of 1.4 and 12.8 at the typical and maximum application rates, respectively. This evaluation indicates that direct spray impacts may pose a risk to large herbivorous mammals, primarily when the maximum application rate is used.

Non-target Plants – Terrestrial and Aquatic

Risk quotients for non-target terrestrial plants ranged from 61.0 to 273, and RQs for non-target aquatic plants ranged from 0.267 to 107. All of the terrestrial plant RQs were above the plant LOC of 1, indicating that direct spray impacts may pose a risk to these receptors. Aquatic plant RQs were below the plant LOC in the acute pond scenarios and above the plant LOC in all other pond and stream scenarios, indicating the potential for acute risk in the stream and long-term risk of harm in the pond and stream.

Fish and Aquatic Invertebrates

Acute toxicity RQs for fish and aquatic invertebrates were below the most conservative LOC of 0.05 (acute RTE species), indicating that direct spray impacts are not likely to pose a risk to these aquatic species. In addition, all chronic toxicity RQs for fish and aquatic invertebrates were well below the LOC for chronic risk to RTE species (0.5). These results indicate that impacts from direct spray are generally not likely to pose acute or chronic risk to these aquatic species.

Off-site Drift

Non-target Plants – Terrestrial and Aquatic

Most of the RQs for typical species of non-target terrestrial plants affected by off-site drift to off-site soils were below the plant LOC of 1. RQs for typical non-target terrestrial plants were elevated (ranging from 1.30 to 2.14) when located 25 ft from ground application with a low boom at the maximum application rate and with a high boom at the typical or maximum application rate. RQs for several application scenarios with RTE plant species did exceed the LOC, with RQs between 1.09 and 5.74. At the typical application rate, elevated RQs for RTE species were predicted 25 ft from ground application with a low boom and 100 ft from ground application with a high boom. At the maximum application rate, elevated RQs for RTE species were predicted 100 ft from ground application with a low or high boom. These results indicate the potential for risk to typical and RTE species located at least 25 to 100 ft from the application area, depending on the boom height and application rate.

The majority of the RQs for non-target aquatic plants affected by off-site drift were above the plant LOC of 1, indicating the potential for negative impacts as a result of off-site drift to waterbodies. Acute and chronic RQs in the pond and stream were elevated above the LOC for all aerial application scenarios, suggesting that sulfometuron methyl should not be spray aerially or that a buffer zone of more than 900 ft (maximum modeled distance) is needed. Elevated RQs were also predicted 100 ft from ground application areas. These results indicate that off-site drift has the potential to negatively impact aquatic plants, but that impact may be reduced through the use of wider buffer zones or the use of ground rather than aerial applications.

Fish and Aquatic Invertebrates

Acute toxicity RQs for fish and aquatic invertebrates were all below the most conservative LOC of 0.05 (acute RTE species). All chronic RQs were well below the LOC for chronic risk to RTE species (0.5). These

results indicate that off-site drift is not likely to pose acute or chronic risk to these aquatic species.

Piscivorous Birds

Risk quotients for the piscivorous bird were all well below the most conservative terrestrial animal LOC (0.1), indicating that this scenario is not likely to pose a risk to piscivorous birds.

Surface Runoff

Non-target Plants – Terrestrial and Aquatic

RQs for typical non-target terrestrial plant species affected by surface runoff to off-site soil were all below the plant LOC of 1, indicating that transport due to surface runoff is not likely to pose a risk to these receptors. Most RQs for RTE non-target terrestrial plant species were also below the plant LOC of 1. However, several scenarios did result in elevated RQs at the typical and maximum application rates. These scenarios included the base watershed with clay soils and more than 25 inches of precipitation per year and three variations on the base watershed with 50 inches of precipitation per year (silt loam, silt, and clay-loam soil). This indicates the potential for risk to RTE plant species in selected watersheds dominated by clay soils at the typical and maximum application rates with greater than 25 inches annual precipitation, with additional risk associated with soils dominated by silt and clay under situations exceeding 50 inches annual precipitation.

Acute and chronic RQs for non-target aquatic plants in the stream impacted by overland flow of herbicide were all below the plant LOC of 1. Acute RQs for non-target aquatic plants in the pond were also below the plant LOC, with one exception. An RQ of 1.04 was predicted at the maximum application rate in the base watershed with sandy soil and 150 inches of precipitation per year. However, this LOC exceedance was minimal and in general these results indicate that this transport mechanism is not likely to pose a risk to aquatic plant species under these conditions.

Chronic RQs exceeded the LOC for several pond scenarios. Elevated RQs ranged from 1.02 to 3.74 at the typical application rate and from 1.15 to 4.06 at the maximum application rate. Risk quotients above the plant LOC of 1 were predicted in 14 scenarios at the typical application rate and 16 scenarios at the maximum application rate. The maximum RQ was predicted in the base watershed with clay soils and 50 inches of precipitation per year.

Fish and Aquatic Invertebrates

Acute toxicity RQs for fish and aquatic invertebrates were all below the most conservative LOC of 0.05 (acute RTE species) for all pond and stream scenarios, indicating that impacts from surface runoff are not likely to pose a risk to these aquatic species.

Chronic risk RQs were well below the LOC for chronic risk to RTE species (0.5), indicating that these scenarios are not likely to result in long-term risk to aquatic animals in the stream or pond.

Piscivorous Birds

RQs for the piscivorous bird were all well below the most conservative terrestrial animal LOC (0.1), indicating that this scenario is not likely to pose a risk to piscivorous birds.

Wind Erosion and Transport Off-site

RQs for typical and RTE terrestrial plants were all well below the plant LOC (1), indicating that wind erosion is not likely to pose a risk to non-target terrestrial plants.

Accidental Spill to Pond

Risk quotients for the spill scenario were 0.0040 for aquatic invertebrates, 0.043 for fish and 14.3 for non-target aquatic plants. These scenarios are highly conservative and represent unlikely and worst case conditions (limited waterbody volume, tank mixed for maximum application). Spills of this magnitude are possible, but are not likely to occur. However, potential risk to non-target aquatic plants was indicated for the truck spill mixed for the maximum application rate.

Potential Risk to Salmonids from Indirect Effects

Qualitative Evaluation of Impacts to Prey

No RQs in excess of the appropriate acute or chronic LOCs were observed for fish or aquatic invertebrates in any of the stream scenarios. Because fish and aquatic invertebrates are not predicted to be directly impacted by herbicide concentrations in the stream, their availability as prey item populations is not likely to be impacted, and there is not likely to be an indirect effect on salmonids due to a lack of prey.

Qualitative Evaluation of Impacts to Vegetative Cover

No RQs in excess of the LOC were observed for aquatic plant species in the stream for any of the off-site drift or surface runoff scenarios. RQs for terrestrial plants were elevated above the LOC for accidental direct spray scenarios at both the typical and maximum application rates, indicating the potential for a reduction in this plant community. RQs for non-target typical and RTE terrestrial plants were also observed above the plant LOC as a result of off-site drift. At the typical application rate, elevated RQs were predicted 25 ft from ground application with a low boom and 100 ft from ground application with a high boom. At the maximum application rate, elevated RQs were predicted 100 ft from ground application with a low or high boom. Risk quotients in excess of the LOC were also predicted for RTE terrestrial plants due to surface runoff in clay watersheds with at least 25 inches of precipitation per year and in clay-loam, silt-loam, and silt watersheds with at least 50 inches of precipitation per year. These results indicate the potential for a reduction in riparian cover under selected conditions as a result of off-site drift and/or surface runoff.

Sulfometuron Methyl

Direct Spray

Terrestrial Wildlife

Risk quotients for terrestrial wildlife were all below the most conservative LOC of 0.1 (acute RTE species), indicating that direct spray impacts are not likely to pose a risk to terrestrial animals.

Non-target Plants – Terrestrial and Aquatic

The majority of RQs for terrestrial and aquatic plants were above the LOC of 1.0. Risk quotients for non-target terrestrial plants ranged from 0.636 to 13,571. Risk quotients for non-target aquatic plants under the accidental direct spray over pond scenario ranged from 131 to 1,060, and the RQs for the accidental direct spray over stream scenario ranged from 650 to 5,320. Therefore, direct spray impacts pose a risk to plants in both aquatic and terrestrial environments. The only exception was the accidental direct spray of the non-target terrestrial plants at the typical application rate.

Fish and Aquatic Invertebrates

Acute and chronic toxicity RQs for fish and aquatic invertebrates were below the most conservative LOCs (0.05 for acute risk RTE species; 0.5 for chronic risk RTE species). These results indicate that direct spray impacts are not likely to pose a risk to fish and aquatic invertebrates.

Off-site Drift

Non-target Plants – Terrestrial and Aquatic

The RQs for typical non-target terrestrial plants affected by off-site drift to soils were all below the plant LOC of 1. However, RQs for all of the RTE non-target terrestrial plants did exceed the LOC, with RQs between 3.43 and 2,536. Risks were more significant for helicopter forested applications than for any other scenario. These results indicate that off-site drift is not likely to result in significant risk to typical non-target terrestrial species, but risks to RTE species may occur.

The majority of the RQs for non-target aquatic plants affected by off-site drift were above the plant LOC of 1, indicating the potential for negative impacts as a result of off-site drift to waterbodies. Acute and chronic RQs in the pond and stream were elevated above the LOC for all aerial application scenarios, suggesting that sulfometuron methyl should not be sprayed aerially or that a buffer zone of more than 900 ft (maximum modeled distance) is needed. Elevated RQs were also predicted 100 ft from ground application areas. These results indicate that off-site drift has the potential to negatively impact aquatic plants, but that impact may be reduced through the use of wider buffer zones or the use of ground rather than aerial applications.

Fish and Aquatic Invertebrates

Acute and chronic toxicity RQs for fish and aquatic invertebrates were all below the most conservative LOCs. These results indicate that impacts from off-site drift are not likely to pose acute or chronic risk to these aquatic species.

Piscivorous Birds

Risk quotients for piscivorous birds were all well below the most conservative terrestrial animal LOC (0.1), indicating that this scenario is not likely to pose a risk to piscivorous birds.

Surface Runoff

Non-target Plants – Terrestrial and Aquatic

Risk quotients for typical non-target terrestrial plant species affected by surface runoff to off-site soil were all below the plant LOC of 1, indicating that transport due to surface runoff is not likely to pose a risk to these species. Risk quotients for RTE species were elevated over the plant LOC for several scenarios. At the typical application rate, elevated RQs for RTE species were predicted in the base watershed with clay soils and more than 10 inches of precipitation per year, in the base watershed with loam soil and 150 inches of precipitation per year, and in the base watershed with two soil variations (silt-loam and clay-loam) at 50 inches of precipitation per year. Chronic RQs were elevated in these same scenarios as well as in the base watershed with loam soil and more than 100 inches of precipitation per year and in the base watershed with silt soil and 50 inches of precipitation per year.

Acute and chronic RQs for non-target aquatic plants in the pond impacted by herbicide runoff were above the plant LOC of 1 for most scenarios. Only watersheds with relatively minimal annual precipitation (5 to 25 inches, depending on soil type) did not predict elevated RQs.

Acute toxicity RQs for aquatic plants in the stream were elevated above the plant LOC in 13 scenarios at the typical application rate and 17 scenarios at the maximum application rate. At the typical rate the following scenarios predicted potential risk: base watershed with sandy soil and greater than 25 inches of annual precipitation, base watershed with clay soil and greater than 100 inches of annual precipitation, and base watershed with loam soil and greater than 150 inches of annual precipitation. The four additional scenarios predicting risk at the maximum application rate were: base watershed with clay soil and greater than 50 inches of annual precipitation; base watershed with loam soil and greater than 100 inches of annual precipitation; base watershed with clay-loam soil and greater than 5 inches of annual precipitation; and base watershed with loam soil, greater than 5 inches of annual precipitation, and a 1,000 acre application area.

Minimal chronic risk to aquatic plants was predicted in the stream, with RQs of 1.02 predicted in two scenarios: base watershed with sand soil and 200 or 250 inches of annual precipitation. At the maximum application rate, elevated RQs were also predicted in the base watershed with sand soil and greater than 50 inches of annual precipitation.

These results indicate the potential for risk to terrestrial and aquatic plants due to surface runoff under most conditions.

Fish and Aquatic Invertebrates

Acute toxicity RQs for fish and aquatic invertebrates were all below the most conservative LOC of 0.05 (acute RTE species) for all pond and stream scenarios, indicating that impacts from surface runoff are not likely to pose a risk to these aquatic species. In addition, chronic risk RQs were well below the LOC for chronic risk to RTE species (0.5); therefore, surface runoff scenarios are not likely to result in long-term risk to aquatic animals in the stream or pond.

Piscivorous Birds

Risk quotients for the piscivorous bird were all well below the most conservative terrestrial animal LOC (0.1), indicating that surface runoff is not likely to pose a risk to piscivorous birds.

Wind Erosion and Transport Off-site

Risk quotients for typical and RTE terrestrial plants were all well below the plant LOC (1), indicating that wind erosion is not likely to pose a risk to non-target terrestrial plants.

Accidental Spill to Pond

Risk quotients for the spill scenarios were below the associated acute LOC for fish and aquatic invertebrates. However, potential risk to non-target aquatic plants was indicated for both the truck and helicopter spills mixed for the maximum application rate.

Potential Risk to Salmonids from Indirect Effects

Qualitative Evaluation of Impacts to Prey

No RQs in excess of the appropriate acute or chronic LOCs were observed for aquatic invertebrates in any of the stream scenarios; therefore, salmonids are not likely to be indirectly affected by a reduction in prey.

Qualitative Evaluation of Impacts to Vegetative Cover

Aquatic plant RQs for accidental direct spray scenarios were above the plant LOC at both the typical and maximum application rates, indicating the potential for a reduction in the aquatic plant community. Therefore, in the unlikely case that a stream is accidentally sprayed, there would be the potential for indirect impacts to salmonids caused by a reduction in available cover.

Elevated aquatic plant RQs were also observed as a result of off-site drift more than 900 ft from aerial application and within 100 ft of the ground application of the herbicide, indicating the potential for a reduction in cover. Elevated RQs were also predicted for several surface runoff scenarios: primarily in sand watersheds with more than 25 inches of annual precipitation; clay watersheds with more than 50 inches of annual precipitation; and loam watersheds with more than 100 inches of annual precipitation.

Risk quotients for terrestrial plants were elevated above the LOC for accidental direct spray scenarios at both the typical and maximum application rates, indicating the potential for a reduction in riparian cover.

Risk quotients for RTE terrestrial plants were observed above the plant LOC under all of the modeled conditions. No risks were predicted for typical plant species. A similar pattern was also predicted for risks due to surface runoff. These results further indicate the potential for a reduction in riparian cover and possible indirect impacts to salmonids.

Tebuthiuron

Direct Spray

Terrestrial Wildlife

Risk quotients for the pollinating insect were above the most conservative LOC of 0.1 (acute RTE species) for impacts from direct spray of the insect (typical and maximum application rates) and indirect contact with foliage after direct spray (maximum application rate). These results suggest there may be potential for risk to pollinating insects due to direct spray and indirect contact with foliage.

Acute and chronic RQs for terrestrial wildlife impacted by the typical application rate were all below the most conservative LOC of 0.1 (acute RTE species). At the maximum application rate, three acute exposure scenarios (ingestion of contaminated food by small and large mammalian herbivores and the large avian herbivore) predicted RQs above the most conservative LOC (0.1; acute RTE species). The small mammalian herbivore acute RQ of 1.86 was also above the "acute high risk" LOC of 0.5. Two chronic exposure scenarios (ingestion of contaminated food by the smaller large mammalian herbivores) were above the chronic LOC of 1, with an RQ, of 3.58 and 3.79, respectively, at the maximum application rate. These results indicate that direct spray impacts are not likely to pose a risk to terrestrial animals at the typical application rate. Acute and chronic risk to avian and mammalian herbivores is predicted at the maximum application rate.

Non-target Plants – Terrestrial and Aquatic

Risk quotients for non-target terrestrial plants ranged from 16.7 to 400. Risk quotients for non-target aquatic plants in the pond ranged from 1.12 to 39.5, and RQs for non-target aquatic plants in the stream ranged from 5.6 to 172. Therefore, direct spray impacts pose a risk to plants in both aquatic and terrestrial environments.

Fish and Aquatic Invertebrates

Acute and chronic toxicity RQs for fish, and acute toxicity RQs for aquatic invertebrates were below the most conservative LOC of 0.05 (acute RTE species), indicating that direct spray impacts are not likely to pose acute or chronic risk to fish or acute risk to aquatic invertebrates in the pond or stream.

The chronic RQs for the aquatic invertebrates for the accidental direct spray ranged from 0.56 to 4.48 for the pond scenario and from 2.8 to 22.4 for the stream scenario. These values were greater than the LOC for chronic risk to RTE species (0.5), indicating the potential for risk to these receptors. These results suggest that impacts from direct spray may pose a chronic risk to RTE aquatic invertebrates in the pond or stream.

Off-site Drift

Non-target Plants – Terrestrial and Aquatic

The majority of the RQs for non-target terrestrial plants affected by off-site drift to soil were below the plant LOC of 1. However, RQs for 6 of the 24 application scenarios did exceed the LOC, with RQs

between 1.04 and 6.59. Elevated RQs were predicted for RTE species impacted by off-site drift in the following situations: 25 ft from the ground application using a high boom at the typical application rate, 25 ft from the ground application using a low or a high boom at the maximum application rate, and 100 ft from the ground application using a high boom at the maximum application rate.

All of the acute and chronic toxicity RQs for non-target aquatic plants affected by off-site drift in the pond and stream were below the plant LOC of 1. These results indicate that impacts from off-site drift are not likely to pose acute or chronic risk to aquatic plants.

Fish and Aquatic Invertebrates

Acute and chronic toxicity RQs for fish and aquatic invertebrates were all below the most conservative LOCs. These results indicate that impacts from off-site drift are not likely to pose acute or chronic risk to these aquatic species.

Piscivorous Birds

Risk quotients for the piscivorous bird were all well below the most conservative terrestrial animal LOC (0.1), indicating that off-site drift of tebuthiuron is not likely to pose a risk to piscivorous birds.

Surface Runoff

Non-target Plants – Terrestrial and Aquatic

Risk quotients for typical, non-target terrestrial plant species affected by surface runoff to off-site soil were all below the plant LOC of 1, indicating that transport due to surface runoff is not likely to pose a risk to these species. Risk quotients for RTE species were elevated for four scenarios at the typical application rate: runoff from the base watershed with clay soil and annual precipitation of 100, 150, 200, and 250 inches (RQs ranged from 1.24 to 1.43). Risk quotients for RTE species were elevated for eight scenarios at the maximum application rate: runoff from the base watershed with clay soil and annual precipitation of 50, 100, 150, 200, and 250 inches and runoff from the base watershed with annual precipitation of 50 inches and three different soil types—silt-loam, silt, and clay-loam (RQs ranged from 1.34 to 11.5). These risk scenarios involve high levels of precipitation (50 inches and greater), and therefore, are not likely on most public lands, which experience arid and semi-arid conditions.

Acute RQs for non-target aquatic plants in the pond impacted by runoff of herbicide were generally below the plant LOC of 1 at the typical application rate. However, elevated acute RQs were predicted at the typical application rate in the base watershed with sandy soil and precipitation greater than 10 inches per year, in the base watershed with clay soil and precipitation of 50 to 100 inches per year, and in the clay loam variation of the base watershed with 50 inches of precipitation per year (no other precipitation levels modeled for this watershed). At the maximum application rate, elevated RQs were predicted in all but five modeled scenarios. These results indicate there is potential for acute impacts to aquatic plants in the pond under selected conditions at the typical application rate and under most conditions at the maximum application rate.

Chronic RQs for non-target aquatic plants in the pond were elevated above the plant LOC in several scenarios. At the typical application rate, 10 of the 42 RQs were above the plant LOC (ranging from 1.29 to 10.2). The majority of these exceedances occurred in sandy watersheds. At the maximum application rate, 37 of the 42 RQs were above the plant LOC. These results suggest the potential for chronic impacts to aquatic plants in the pond under selected conditions at the typical application rate and under most conditions at the maximum application rate.

Acute RQs for non-target aquatic plants in the stream impacted by surface runoff of herbicide were all below the plant LOC of 1 at the typical application rate. At the maximum application rate, elevated acute RQs were predicted in the base watershed with sandy soil and more than 50 inches of precipitation per year, in the base watershed with clay soil and more than 100 inches of precipitation per year, and in the loam watershed at 50 inches of precipitation per year when the application area was increased to 100 and 1,000 acres. Chronic RQs for non-target aquatic plants in the stream were below the LOC in all scenarios. These results indicate the potential for acute, but not chronic, impacts to aquatic plants in the stream under selected conditions at the maximum application rate.

Fish and Aquatic Invertebrates

Acute toxicity RQs for fish and aquatic invertebrates were all below the most conservative LOC of 0.05 (acute RTE species) for all pond and stream scenarios,

indicating that surface runoff of tebuthiuron is not likely to pose acute risks to these aquatic species.

Chronic risk RQs for fish were well below the LOC for chronic risk to RTE species (0.5) in both pond and stream scenarios. At the typical application rate, chronic risk RQs for aquatic invertebrates were below the LOC for chronic risk to RTE species (0.5) in all but one modeled scenario (RQ of 1.28 for base watershed with sand soil and 10 inches of precipitation per year). At the maximum application rate in the pond scenario, chronic RQs for aquatic invertebrates were elevated above the LOC for chronic risk to RTE species (0.5) in 31 of 42 scenarios. In addition, 11 of the 42 pond RQs were above the chronic risk LOC (1). The majority of these elevated RQs occurred in watersheds with sandy soil. No RQs for aquatic invertebrates in the stream scenario were above their LOCs.

These results indicate that these scenarios are not likely to result in long-term risk to fish in the stream or pond or to aquatic invertebrates in the stream at the typical application rate. Long-term impacts to aquatic invertebrates in the pond, especially RTE species, may occur at the maximum application rate.

Piscivorous Birds

Risk quotients for the piscivorous bird were all well below the most conservative terrestrial animal LOC (0.1), indicating that surface runoff is not likely to pose a risk to piscivorous birds.

Wind Erosion and Transport Off-site

Risk quotients for typical and RTE terrestrial plants were all well below the plant LOC (1), indicating that wind erosion is not likely to pose a risk to non-target terrestrial plants.

Accidental Spill to Pond

Risk quotients for the truck spill scenario ranged from 0.048 for aquatic invertebrates to 287 for non-target aquatic plants. Risk quotients for the helicopter spill scenario were higher, ranging from 0.196 for aquatic invertebrates to 1,170 for non-target aquatic plants. Potential risk to fish and non-target aquatic plants was indicated for the truck spill, and risk to fish, aquatic invertebrates, and non-target aquatic plants was indicated for the helicopter spill.

Potential Risk to Salmonids from Indirect Effects

Qualitative Evaluation of Impacts to Prey

No RQs in excess of the appropriate acute or chronic LOCs were observed for aquatic invertebrates in any of the stream scenarios associated with off-site drift or surface runoff. However, chronic RQs for invertebrates were greater than the associated chronic LOC for the accidental direct spray scenario. Because aquatic invertebrates are not predicted to be directly impacted by herbicide concentrations in the stream during *normal* application of tebuthiuron, salmonids are not likely to be indirectly affected by a reduction in prey.

Qualitative Evaluation of Impacts to Vegetative Cover

Aquatic plant RQs for accidental direct spray scenarios were above the plant LOC at both the typical and maximum application rates. Therefore, there is the potential for indirect impacts to salmonids due to a reduction in available cover in the unlikely event that a stream is accidentally sprayed.

No elevated aquatic plant RQs were observed resulting from off-site drift to the stream. Acute RQs in excess of the LOC were observed for aquatic plant species in the stream for selected surface runoff scenarios at the maximum application rate, most strongly within sandy watersheds. No chronic RQs were elevated in the surface runoff scenarios. These results indicate the potential for a reduction in cover in some locations as a result of surface runoff when the herbicide is applied at the maximum rate.

Risk quotients for terrestrial plants were elevated above the LOC for accidental direct spray scenarios at both the typical and maximum application rates, indicating the potential for a reduction in this plant community in response to this unlikely event.

Risk quotients for typical terrestrial plants were also observed above the plant LOC as a result of off-site drift 25 ft from the ground application of the herbicide at the maximum rate. In addition, elevated RQs at the typical application rate were observed for RTE species at 25 ft from the ground application using a high boom. Elevated RQs at the maximum application rate were observed for RTE species at 25 ft from the ground application and 100 ft from the ground application using a high boom. These results indicate the potential for a reduction in riparian cover under

selected conditions as a result of off-site drift from a nearby tebuthiuron application.

No RQs in excess of the LOC were observed for typical terrestrial plant species for any of the surface runoff scenarios. Elevated RQs as a result of surface runoff were observed for RTE terrestrial plant species in 4 of 42 scenarios at the typical application rate and 8 of 42 scenarios at the maximum application rate. Therefore, a reduction in plant cover is likely as a result of accidental direct spray and under selected scenarios as a result of off-site drift and surface runoff. In these circumstances, salmonids could be indirectly affected by the reduction in cover.

Uncertainty Analysis

For any ERA, a thorough description of uncertainties is a key component that serves to identify possible weaknesses in the analysis and to elucidate what impact such weaknesses might have on the final risk conclusions. The uncertainties of this risk assessment are discussed below (also see Table 7-1 in the herbicide ERAs [ENSR 2005a-j]).

Toxicity Data Availability

The majority of the available toxicity data was obtained from studies conducted as part of the USEPA pesticide registration process. There are a number of uncertainties related to the use of this limited data set in the risk assessment. In general, it would be preferable to base any ecological risk analysis on reliable field studies that clearly identify and quantify the amount of potential risk from particular exposure concentrations of the chemical of concern. However, in most risk assessments it is more common to extrapolate the results obtained in the laboratory to the receptors found in the field. It should be noted, however, that laboratory studies often overestimate risk relative to field studies (Fairbrother and Kapustka 1996).

Species for which toxicity data are available may not necessarily be the most sensitive species to a particular herbicide. These species have been selected as laboratory test organisms because they are generally sensitive to stressors and can also be maintained under laboratory conditions. Toxicity values for the most appropriate sensitive surrogate species for each receptor were selected by qualified toxicologists based on a thorough review of the available toxicity data; however, there is a possibility that some non-tested receptors in a given receptor group would be more sensitive.

Furthermore, the surrogate species used in the registration testing are not an exact match to the wildlife receptors included in the ERA. For example, avian data are only available for two primarily herbivorous birds: the mallard duck and the bobwhite quail. However, TRVs based on these receptors were also used to evaluate risk to insectivorous and piscivorous birds. Species with alternative feeding habits may be more or less sensitive to the herbicide than those species tested in the laboratory (see Tables C-3 and C-4 for a list of surrogate species and their receptor groups).

In general, the most sensitive available endpoint for the appropriate surrogate test species was used to derive TRVs. This approach is conservative as there may be a wide range of data and effects for different species. For example, the EC_{50}s available for aquatic invertebrates exposed to bromacil ranged from 65 mg a.i./L to >1,000 mg a.i./L. Accordingly, 65 mg a.i./L was selected as the aquatic invertebrate TRV, even though the majority of results were well above this value. In general, this selection criterion for TRVs has the potential to overestimate risk within the ERA.

In addition, several of the toxicity tests conducted during the registration process did not use herbicide formulations with 100% a.i. The assumption has been made that any toxicity observed in the tests is due to the herbicide a.i.; however, it is possible that the additional ingredients in the different formulations also had an effect. For purposes of TRV derivation and the ERA, it was assumed that all toxicity data applies to the a.i. itself and not the particular product formulation tested. This may result in an overestimate of risk to certain receptors and species guilds.

Degradates, Inert Ingredients, Adjuvants, and Tank Mixtures

In a detailed herbicide risk assessment, it is preferable to estimate risks not just from the a.i. of an herbicide, but also from the cumulative risks of degradates, inert ingredients (inerts), and adjuvants. Other pesticides may also factor into the risk estimates, as herbicides can be tank mixed to expand the level of control and to accomplish multiple identified tasks (the BLM usually only tank mixes herbicides with other herbicides). However, using currently available models (e.g., GLEAMS), it is only practical to make deterministic

TABLE C-15
Risk Levels Used to Describe Typical Herbicide Effects According to Exposure Scenario and Ecological Receptor Group

	BROMACIL		CHLOR		DIFLU		DIQUAT		DIURON		FLURIDONE		IMAZAPIC		OVERDRIVE		SULFM		TEBU	
	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max
Direct Spray																				
Terrestrial animals	0 [14:16]	0 [8:16]	0 [16:16]	0 [16:16]	0 [16:16]	0 [16:16]	0 [10:16]	M [7:16]	0 [12:16]	0 [6:16]	0 [16:16]	0 [15:16]	0 [16:16]	0 [16:16]	0 [15:16]	0 [15:16]	0 [16:16]	0 [16:16]	0 [15:16]	0 [9:16]
Terrestrial plants	H [1:1]	H [1:1]	H [1:1]	H [1:1]	M [1:1]	H [1:1]	H [1:1]	H [1:1]	M [1:1]	H [1:1]	NE	NE	L [1:1]	M [1:1]	M [1:1]	H [1:1]	0 [1:1]	L [1:1]	M [1:1]	H [1:1]
RTE terrestrial plants	H [1:1]	H [1:1]	H [1:1]	H [1:1]	H [1:1]	H [1:1]	H [1:1]	H [1:1]	H [1:1]	H [1:1]	NE	NE	L [1:1]	M [1:1]	H [1:1]	H [1:1]	H [1:1]	H [1:1]	M [1:1]	H [1:1]
Fish pond	L [1:2]	L [1:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	L [2:2]	M [1:2]	M [2:2]	H [1:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]
Fish stream	M [1:2]	M [1:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	M [1:2]	M [2:2]	H [1:1]	H [1:1]	0 [2:2]	L [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]
Aquatic invertebrates pond	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	M [2:2]	H [1:2]	M [2:2]	H [1:2]	0 [2:2]	L [1:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	L [1:2]	L [1:2]
Aquatic invertebrates stream	0 [2:2]	L [1:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	H [1:2]	H [2:2]	H [1:1]	H [1:1]	L [1:2]	M [1:2]	0 [2:2]	L [1:2]	0 [2:2]	0 [2:2]	0 [2:2]	0 [2:2]	L [1:2]	M [1:2]
Aquatic plants pond	H [1:2]	H [2:2]	M [1:2]	H [2:2]	L [1:2]	L [1:2]	H [2:2]	H [2:2]	H [2:2]	H [2:2]	0 [2:2]	0 [2:2]	L [1:2]	L [2:2]	M [1:2]	M [1:2]	H [2:2]	H [2:2]	L [2:2]	M [1:2]
Aquatic plants stream	H [2:2]	H [2:2]	M [2:2]	H [2:2]	L [1:2]	L [1:2]	H [2:2]	H [2:2]	H [1:1]	H [1:1]	0 [2:2]	0 [2:2]	L [2:2]	M [2:2]	M [1:2]	H [1:2]	H [2:2]	H [2:2]	M [1:2]	H [1:2]
Piscivorous bird	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0 [1:1]	0 [1:1]	NA	NA	NA	NA	NA	NA	NA	NA
Accidental Spill																				
Fish pond	NE	M [1:1]	NE	0 [2:2]	NE	0 [1:1]	NE	H [2:2]	NE	H [1:1]	NE	M [2:2]	NE	0 [2:2]	NE	0 [1:1]	NE	0 [2:2]	NE	M [1:2]
Aquatic invertebrates pond	NE	L [1:1]	NE	0 [2:2]	NE	0 [1:1]	NE	H [2:2]	NE	H [1:1]	NE	H [1:2]	NE	0 [2:2]	NE	0 [1:1]	NE	0 [2:2]	NE	L [1:2]
Aquatic plants pond	NE	H [1:1]	NE	H [2:2]	NE	H [1:1]	NE	H [2:2]	NE	H [1:1]	NE	L [2:2]	NE	H [2:2]	NE	M [1:1]	NE	H [2:2]	NE	H [2:2]

TABLE C-15 (Cont.)
Risk Levels Used to Describe Typical Herbicide Effects According to Exposure Scenario and Ecological Receptor Group

	BROMACIL		CHLOR		DIFLU		DIQUAT		DIURON		FLURIDONE		IMAZAPIC		OVERDRIVE		SULFM		TEBU	
	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max
Off-Site Drift																				
Terrestrial animals	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA
Terrestrial plants	M [3:6]	M [3:6]	M [5:12]	M [8:12]	0 [4:6]	0 [4:6]	L [7:12]	M [7:12]	0 [5:6]	L [4:6]	NE	NE	0 [18:18]	0 [13:18]	0 [5:6]	0 [4:6]	0 [12:12]	0 [12:12]	0 [6:6]	0 [4:6]
RTE terrestrial plants	M [3:6]	H [3:6]	M [7:12]	M [7:12]	L [4:6]	L [4:6]	M [7:12]	M [7:12]	M [3:6]	H [3:6]	NE	NE	0 [17:18]	0 [13:18]	L [3:6]	L [4:6]	H [5:12]	H [8:12]	0 [5:6]	L [3:6]
Fish pond	0 [12:12]	0 [12:12]	0 [24:24]	0 [24:24]	0 [12:12]	0 [12:12]	NA	NA	0 [12:12]	0 [11:12]	NA	NA	0 [36:36]	0 [36:36]	0 [12:12]	0 [12:12]	0 [24:24]	0 [24:24]	0 [12:12]	0 [12:12]
Fish stream	0 [12:12]	0 [12:12]	0 [24:24]	0 [24:24]	0 [12:12]	0 [12:12]	NA	NA	0 [12:12]	0 [9:12]	NA	NA	0 [36:36]	0 [36:36]	0 [12:12]	0 [12:12]	0 [24:24]	0 [24:24]	0 [12:12]	0 [12:12]
Aquatic invertebrates pond	0 [12:12]	0 [12:12]	0 [24:24]	0 [24:24]	0 [12:12]	0 [12:12]	NA	NA	0 [12:12]	0 [9:12]	NA	NA	0 [36:36]	0 [36:36]	0 [12:12]	0 [12:12]	0 [24:24]	0 [24:24]	0 [12:12]	0 [12:12]
Aquatic invertebrates stream	0 [12:12]	0 [12:12]	0 [24:24]	0 [24:24]	0 [12:12]	0 [12:12]	NA	NA	0 [11:12]	0 [8:12]	NA	NA	0 [36:36]	0 [36:36]	0 [12:12]	0 [12:12]	0 [24:24]	0 [24:24]	0 [12:12]	0 [12:12]
Aquatic plants pond	0 [9:12]	L [7:12]	0 [24:24]	0 [24:24]	0 [9:12]	0 [8:12]	NA	NA	L [8:12]	M [6:12]	NA	NA	0 [36:36]	0 [34:36]	0 [9:12]	0 [8:12]	L [13:24]	L [12:24]	0 [12:12]	0 [12:12]
Aquatic plants stream	0 [8:12]	L [6:12]	0 [24:24]	0 [22:24]	0 [8:12]	L [6:12]	NA	NA	L [6:12]	M [6:12]	NA	NA	0 [36:36]	0 [33:36]	0 [8:12]	L [6:12]	L [14:24]	L [10:24]	0 [12:12]	0 [12:12]
Piscivorous bird	0 [6:6]	0 [6:6]	0 [12:12]	0 [12:12]	0 [6:6]	0 [6:6]	NA	NA	0 [6:6]	0 [6:6]	NA	NA	0 [18:18]	0 [18:18]	0 [6:6]	0 [6:6]	0 [12:12]	0 [12:12]	0 [6:6]	0 [6:6]
Surface Runoff																				
Terrestrial animals	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Terrestrial plants	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]	NA	NA	0 [42:42]	0 [42:42]	NA	NA	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]
RTE terrestrial plants	0 [39:42]	0 [38:42]	0 [42:42]	0 [42:42]	0 [34:42]	0 [33:42]	NA	NA	0 [38:42]	0 [34:42]	NA	NA	0 [42:42]	0 [42:42]	0 [34:42]	0 [33:42]	0 [32:42]	0 [28:42]	0 [38:42]	0 [34:42]
Fish pond	0 [65:84]	0 [46:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	NA	NA	L [60:84]	L [48:84]	NA	NA	0 [84:84]	0 [84:84]	0 [84:84]	0 [47:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]
Fish stream	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	NA	NA	0 [81:84]	0 [68:84]	NA	NA	0 [84:84]	0 [84:84]	0 [84:84]	0 [83:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]

TABLE C-15 (Cont.)
Risk Levels Used to Describe Typical Herbicide Effects According to Exposure Scenario and Ecological Receptor Group

	BROMACIL		CHLOR		DIFLU		DIQUAT		DIURON		FLURIDONE		IMAZAPIC		OVERDRIVE		SULFM		TEBU	
	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max
Surface Runoff (Cont.)																				
Aquatic invertebrates pond	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	NA	NA	0 [38:84]	L [34:84]	NA	NA	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [83:84]	0 [53:84]
Aquatic invertebrates stream	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	NA	NA	0 [66:84]	0 [49:84]	NA	NA	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]	0 [84:84]
Aquatic plants pond	M [70:84]	H [45:84]	0 [64:84]	0 [53:84]	0 [84:84]	0 [84:84]	NA	NA	M [50:84]	H [64:84]	NA	NA	0 [80:84]	0 [62:84]	0 [70:84]	0 [67:84]	L [42:84]	L [38:84]	0 [65:84]	L [55:84]
Aquatic plants stream	0 [45:84]	L [55:84]	0 [80:84]	0 [77:84]	0 [84:84]	0 [84:84]	NA	NA	L [35:84]	L [39:84]	NA	NA	0 [84:84]	0 [83:84]	0 [84:84]	0 [84:84]	0 [69:84]	0 [60:84]	0 [84:84]	0 [74:84]
Piscivorous bird	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]	NA	NA	0 [42:42]	0 [42:42]	NA	NA	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]	0 [42:42]
Wind Erosion																				
Terrestrial animals	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Terrestrial plants	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]	NA	NA	0 [9:9]	0 [9:9]	NA	NA	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]
RTE terrestrial plants	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]	NA	NA	0 [9:9]	0 [9:9]	NA	NA	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]	0 [9:9]
Fish pond	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fish stream	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aquatic invertebrates pond	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aquatic invertebrates stream	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aquatic plants pond	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aquatic plants stream	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Piscivorous bird	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE C-15 (Cont.)
Risk Levels Used to Describe Typical Herbicide Effects According to Exposure Scenario and Ecological Receptor Group

Notes:
The reported risk level is based on the risk level of the majority of the RQs for each exposure scenario within each of the above receptor groups and exposure categories (i.e., direct spray/spill, off-site drift, surface runoff, wind erosion). As a result, risk may be higher than the reported risk category for some scenarios within each category. The reader should consult the risk tables in Section 4 of the ERAs to determine the specific scenarios that result in the displayed level of risk for a given receptor group.

Abbreviations
CHLOR = Chlorsulfuron
DIFLU = Diflufenzopyr
SULFM = Sulfometuron methyl
TEBU = Tebuthiuron

Risk Categories
0 = No Risk (RQ<LOC)
L = Low Risk (RQ 1-10x LOC)
M = Moderate Risk (RQ 10-100x LOC)
H = High Risk (RQ >100 LOC)

NA = Not Applicable
NE = Not Evaluated
Typ = Typical application rate
Max = Maximum application rate

Number in brackets represents Number of RQs in the Indicated Risk Level:Number of Scenarios Evaluated

risk calculations (i.e., exposure modeling, effects assessment, and RQ derivations) for a single a.i.

In addition, information on inerts, adjuvants, and degradates is often limited by the availability of, and access to, reliable toxicity data for these constituents. The sections below present a qualitative evaluation of the potential risks from degradates, inert ingredients, adjuvants, and tank mixtures.

Degradates

The potential toxicity of degradates should be considered when selecting an herbicide. However, it is beyond the scope of this risk assessment to evaluate all of the possible degradates of the various herbicide formulations of the ten herbicides. Degradates may be more or less mobile and more or less toxic in the environment than their source herbicides (Battaglin et al. 2003). Differences in environmental behavior (e.g., mobility) and toxicity between parent herbicides and degradates makes prediction of potential impacts challenging. For example, a less toxic, but more mobile bioaccumulative, or persistent degradate may have a greater adverse impact due to residual concentrations in the environment. A recent study indicated that 70% of degradates had either similar or reduced toxicity to fish, daphnids, and algae than the parent pesticide. However, 4.2% of the degradates were more than an order of magnitude more toxic than the parent pesticide, with a few instances of acute toxicity values below 1 mg/L (Sinclair and Boxall 2003). No evaluations of impacts to terrestrial species were conducted in the study. The lack of data on the toxicity of degradates of the specific herbicides represents a source of uncertainty in the risk assessment.

Inerts

Pesticide products contain both active and inert ingredients. The terms "active ingredient" (a.i.) and "inert ingredient" have been defined by federal law—the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)—since 1947. An a.i. is one that prevents, destroys, repels, or mitigates the effects of a pest, or is a plant regulator, defoliant, desiccant, or nitrogen stabilizer. By law, the a.i. must be identified by name on the label, together with its percentage by weight. An inert ingredient is simply any ingredient in the product that is not intended to affect a target pest. For example, isopropyl alcohol may be an a.i. and antimicrobial pesticide in some products; however, in other products, it is used as a solvent and may be considered an inert ingredient. The law does not require inert ingredients to be identified by name and percentage on the label, but the total percentage of such ingredients must be declared. Because neither the federal law nor the regulations define the term "inert" on the basis of toxicity, hazard or risk to humans, non-target species, or the environment, it should not be assumed that all inert ingredients are non-toxic.

The USEPA has a listing of regulated inert ingredients at http://www.epa.gov/opprd001/inerts/index.html. This listing divides inert ingredients into four lists. The number of inert ingredients found in the nine herbicides evaluated in the ERAs for each category is shown below (nine inerts were not found on the USEPA lists):

List 1 - Inert Ingredients of Toxicological Concern: None.

List 2 - Potentially Toxic Inert Ingredients: None.

List 3 - Inerts of Unknown Toxicity: 12.

List 4 - Inerts of Minimal Toxicity: Over 50.

Toxicity information was also searched in the following sources:

- TOMES (a proprietary toxicological database including USEPA's IRIS, the Hazardous Substance Data Bank, and the Registry of Toxic Effects of Chemical Substances (RTEC).
- USEPA's ECOTOX database which includes AQUIRE (a database containing scientific papers published on the toxic effects of chemicals to aquatic organisms).
- TOXLINE (a literature searching tool).
- Material Safety Data Sheets from suppliers.
- Other sources, such as the Farm Chemicals Handbook.
- Other cited literature sources.

Relatively little toxicity information was found. A few acute studies on aquatic or terrestrial species were reported. No chronic data, no cumulative effects data, and almost no indirect effects data (food chain species) were found for the inerts in the 10 herbicides.

A number of the List 4 compounds (Inerts of Minimal Toxicity) are naturally-occurring earthen materials (e.g., clay materials or simple salts) that would produce no toxicity at applied concentrations. However, some of the inerts, particularly the List 3 compounds and unlisted compounds, may have moderate to high potential toxicity to aquatic species based on information in Material Safety Data Sheets or on published data.

As a tool to evaluate List 3 and unlisted inerts in the ecological risk assessment, the exposure concentration of the inert compound was calculated and compared to toxicity information. As described in more detail in Appendix D of the ERAs, the GLEAMS model was set up to simulate the effects of a generalized inert compound in the base-case watershed (annual precipitation rate of 50 inches per year, application area of 10 acres, slope of 0.05, surface roughness of 0.015, erodibility of 0.401 tons per ac, vegetation type of weeds) with a sand soil type. The chemical characteristics of the generalized inert compound were set at either extremely high or low values to describe it as either a very mobile or stable compound. The application rate of the inert/adjuvant compound was fixed at 1 lb a.i./acre. Under these conditions, the maximum predicted ratio of inert concentration to herbicide application rate was 0.69 mg/L per lb a.i./acre (3 day maximum in the pond), and in every case (acute and chronic, pond and stream scenarios) the inert concentrations exceeded herbicide a.i. concentrations.

In general, higher application rates resulted in higher exposure concentrations of surfactant inerts, exceeding 1 mg/L for the maximum pond scenario. This suggests that inerts associated with the application of herbicides may contribute to acute toxicity to aquatic organisms if they reach the aquatic environment. However, due to the lack of specific inert toxicity data, this may be an overestimate of the potential toxicity. It is assumed that toxic inerts would not represent a substantial percentage of the herbicide and that minimal impacts to the environment would result from these inert ingredients.

Adjuvants and Tank Mixtures

Evaluating the potential additional/cumulative risks from mixtures and adjuvants of pesticides is substantially more difficult than evaluating the inerts in the herbicide composition. While many herbicides are present in the natural environment along with other pesticides and toxic chemicals, it is extremely difficult to estimate the potential cumulative risks of such mixtures. The composition of such mixtures is highly site-specific, and thus nearly impossible to address at the programmatic level of the EIS.

Herbicide label information indicates whether a particular herbicide can be tank mixed with other pesticides. Adjuvants (e.g., surfactants, crop oil concentrates, fertilizers) may also be added to the spray mixture to improve the herbicide efficacy when mixed and applied to according to the label. Without product specific toxicity data, it is impossible to quantify the potential impacts of these mixtures. In addition, a quantitative analysis could only be conducted if reliable scientific evidence allowed a determination of whether the joint action of the mixture was additive, synergistic, or antagonistic. Such evidence is not likely to exist unless the mode of action is common among the chemicals and receptors.

Adjuvants

Adjuvants generally function to enhance or prolong the activity of an a.i. For terrestrial herbicides, adjuvants aid in proper wetting of foliage and absorption of the a.i. into plant tissue. Adjuvant is a broad term that includes surfactants, selected oils, anti-foaming agents, buffering compounds, drift control agents, compatibility agents, stickers, and spreaders. Adjuvants are not under the same registration guidelines as pesticides; the USEPA does not register or approve the labeling of spray adjuvants. Individual herbicide labels contain lists with "label-approved" adjuvants for use with a particular herbicide under specific conditions.

Following the same procedure used to address inerts in Appendix D of the ERAs, the GLEAMS model was used to estimate the potential portion of an adjuvant that might reach an adjacent waterbody via surface runoff. In addition, sources (Muller 1980; Lewis 1991; Dorn et al. 1997; Wong et al. 1997) generally suggest that the acute toxicity of surfactants and anti-foam agents to aquatic life ranges from 1 to 10 mg/L, and that chronic toxicity ranges as low as 0.1 mg/L. This evaluation indicates that, for herbicides with high application rates, adjuvants have the potential to cause acute, and potentially chronic, risk to aquatic species. However, more specific modeling and toxicity data would be necessary to define the level of uncertainty. Selection of adjuvants is under the control of BLM land managers, and it is recommended that land managers follow all label instructions and abide by any warnings. In general, adjuvants compose a relatively

small portion of the volume of herbicide applied; however, selection of adjuvants with limited toxicity and low volumes is recommended to reduce the potential for the adjuvant to influence the toxicity of the herbicide.

Tank Mixtures

The use of tank mixtures of labeled herbicides, along with the addition of an adjuvant (when stated on the label), may be an efficient use of equipment and personnel; however, knowledge of both products and their interactions is necessary to avoid unintended negative effects. In general, herbicide interactions can be classified as additive, synergistic, or antagonistic:

- Additive effects occur when mixing two herbicides produces the same response as the combined effects of each herbicide applied alone. The products neither hurt nor enhance each other.

- Synergistic responses occur when two herbicides provide a greater response than the added effects of each herbicide applied separately.

- Antagonistic responses occur when two herbicides applied together produce less control than if you applied each herbicide separately.

While a quantitative evaluation of all of these mixtures is beyond the scope of this ERA, a qualitative evaluation may be made if the assumption is made that the products in the tank mix will act in an additive manner. The predicted RQs for two active ingredients can be summed for each individual exposure scenario to see if the combined impacts result in additional RQs elevated above the corresponding LOCs.

The RQs for any two herbicides in a tank mix were combined to simulate a tank mix in Appendix E of each ERA (diquat, fluridone, and tebuthiuron are not generally tank mixed by the BLM and were not included in this analysis). The application rates within the tank mix are not necessarily the same as each individual a.i. applied alone. See Table 7-2 in each ERA (ENSR 2005a-j) for a comparison of the percent of RQs exceeding LOCs for each of the 10 herbicide active ingredients applied alone and in a tank mix.

These comparisons indicate that tank mixes for bromacil (with sulfometuron methyl) and imazapic with diflufenzopyr do not result in more RQs above the associated LOCs for birds, mammals, fish, and invertebrates (and aquatic plants for imazapic), than were predicted for bromacil, imazapic, or diflufenzopyr alone. Additional elevated RQs are predicted for both aquatic and RTE terrestrial plants when tank mixes of bromacil with sulfometuron methyl, and imazapic with diflufenzopyr, are applied (aquatic plant risk is not elevated versus imazapic applied alone). This suggests that in some cases plant species may be particularly sensitive to the tank mix. However, when chlorsulfuron and diuron are tank mixed, all receptors are at higher risk than with application of chlorsulfuron alone (risks are not higher than with the application of diuron alone), and most receptors are also at higher risk when sulfometuron methyl is applied with bromacil versus sulfometuron methyl alone.

The comparison of the RQs from herbicide a.i. and tank mixes of these herbicides indicate that results are specific to each tank mix. Aquatic plants and RTE terrestrial plants may be at greater risk from the tank mixed application than from the a.i. alone. However, in some cases all receptors are at greater risk and precautions (e.g., increased buffer zones, decreased application rates) should be taken to reduce risk. There is some uncertainty in this evaluation because herbicides in tank mixes may not interact in an additive manner; this may overestimate risk if the interaction is antagonistic, or it may underestimate risk if the interaction is synergistic. In addition, other products may also be included in tank mixes and may contribute to the potential risk.

Selection of tank mixes, like adjuvants, is under the control of BLM land managers. To reduce uncertainties and potential negative impacts, it is required that land managers follow all label instructions and abide by any warnings. Labels for both tank mixed products should be thoroughly reviewed and mixtures with the least potential for negative effects should be selected. This is especially relevant when a mixture is applied in a manner that may have increased potential for risk. Use of a tank mix under these conditions increases the level of uncertainty in risk to the environment.

Concentration Models

The ecological risk assessment relies on different models (i.e., AgDRIFT, GLEAMS, CALPUFF) to predict the off-site impacts of herbicide use. These models have been developed and applied in order to

produce a conservative estimate of herbicide loss from the application area to off-site locations (via off-site drift, surface runoff, and wind erosion). The uncertainty analysis focused on which environmental characteristics (e.g., soil type, annual precipitation) exert the biggest numeric impact on model outputs. The results of this uncertainty analysis also have important implications for the ability to apply risk calculations to different site characteristics from a risk management perspective.

AgDRIFT®

Off-site spray drift and resulting terrestrial deposition rates and waterbody concentrations (hypothetical pond or stream) were predicted using the computer model, AgDRIFT® Version 2.0.05 (SDTF 2002). As with any complex ecological risk assessment model, a number of simplifying assumptions were made to ensure that the risk assessment results would be protective of most environmental settings encountered in the public land management program.

Predicted off-site spray drift and downwind deposition can be substantially altered by a number of variables intended to simulate the herbicide application process (e.g., nozzle type used in the spray application of an herbicide mixture, ambient wind speed, release height [application boom height], and evaporation). Hypothetically, any variable in the model that is intended to represent some part of the physical process of spray drift and deposition can substantially alter predicted downwind drift and deposition patterns. Recognizing the incomplete knowledge of all the scenarios likely to be encountered in BLM programs, these assumptions were developed to be conservative and likely result in overestimation of actual off-site spray drift and resulting environmental impacts.

GLEAMS

The GLEAMS model was used to predict the loading of herbicide to nearby soils, ponds, and streams from overland runoff, erosion, and root-zone groundwater runoff.

Herbicide Loss Rates

The trends in herbicide loss rates (herbicide loss computed as a percent of the herbicide applied within the watershed) and water concentrations predicted by the GLEAMS model echo trends that have been documented in a wide range of streams located in the Midwestern U.S. A recently published study (Lerch and Blanchard 2003) recognized three primary factors affecting herbicide transport to streams, and they can be organized into four general categories:

- Intrinsic factors – soil and hydrologic properties and geomorphologic characteristics of the watershed
- Anthropogenic factors – land use and herbicide management
- Climate factors – precipitation and temperature
- Herbicide factors – chemical and physical properties and formulation of herbicide product

These findings were based on the conclusions of several prior investigations, data collected as part of the U.S. Geological Survey's (USGS) National Stream Quality Accounting Network (NASQAN) program, and the results of runoff and baseflow water samples collected in 20 streams in northern Missouri and southern Iowa. The investigation concluded that the median runoff loss rates for atrazine, cyanazine, acetochlor, alachlor, metolachlor, and metribuzin ranged from 0.33 to 3.9% of the mass applied—loss rates that were considerably higher than other areas of the U.S. The study indicated that the runoff potential was a critical factor affecting herbicide transport. The median total loss rates range from 0.27 to 36%, and the median runoff loss rates range from 0.02 to 0.27%.

The results of the GLEAMS simulations indicate trends similar to those identified in the Lerch and Blanchard (2003) study. First, the GLEAMS simulations demonstrated that the most dominant factors controlling herbicide loss rates are soil type and precipitation (increased precipitation and less porous soil types result in increased herbicide runoff). This was demonstrated in each of the GLEAMS simulations that considered the effect of highly variable annual precipitation rates and soil type on herbicide transport. In all cases, the GLEAMS model predicted that runoff loss rate was positively correlated with both precipitation rate and soil type. Second, estimating the groundwater discharge concentrations by using the predicted root-zone concentrations as a surrogate is extremely conservative. For example, while the median runoff loss rates predicted using GLEAMS range from 0.02 to 0.27%, the median total loss rates are substantially higher. This discrepancy may be due to the differences between the watershed

characteristics in the field investigation and those used to describe the GLEAMS simulations, as well as to the conservative nature of the baseflow predictions.

Based on the results and conclusions of prior investigations, the runoff loss rates predicted by the GLEAMS model are approximately equivalent to loss rates determined within the Mississippi River watershed and elsewhere in the U.S., but the percolation loss rates are probably conservatively high. This confirms that the GLEAMS modeling approach used in the ERAs either approximates or overestimates the rate of loadings observed in the field.

CALPUFF

The USEPA's CALPUFF air pollutant dispersion model was used to predict impacts of the potential migration of herbicide between 1.5 and 100 km (0.9 and 61 miles) from the application area by windblown soil (fugitive dust). Several assumptions were made that could overestimate or underestimate the deposition rates obtained from this model.

The modeling conservatively assumed that all of the herbicide would be present in the soil at the commencement of a windy event, and that no reduction due to vegetation interception/up-take, leaching, or solar or chemical half-life would occur following aerial application. Thus, the model likely overestimates the deposition rates unless the herbicide is taken by the wind as soon as it is applied. It is more likely that a portion of the applied herbicide would be sorbed to plants or degraded over time.

The model assumes a 1-mm (0.03 inch) penetration depth, which is less than the depth used in previous herbicide risk assessments (SERA 2003) and the depth assumed in the GLEAMS model (1 cm [0.3 inch] surface soil). This penetration depth is conservative and likely overestimates impacts.

The use of flat terrain could underestimate deposition for mountainous areas. In these areas, hills and mountains would likely focus wind and deposition into certain areas, resulting in pockets of increased risk. The use of bare, undisturbed soil results in less uptake and transport than disturbed (e.g., tilled) soil. However, the BLM does not apply herbicides to agricultural areas so this assumption may be appropriate for public lands.

The surface roughness in the vicinity of the application site directly affects the deposition rates predicted by CALPUFF. The surface roughness length used in the CALPUFF model is a measure of the height of obstacles to the wind flow and varies by land-use types. Forested areas and urban areas have the highest surface roughness lengths (0.5 m to 1.3 m [1.6 to 4.3 ft]) while grasslands have the lowest (0.001 m to 0.10 m [0.003 to 0.3 ft]). Predicted deposition rates are likely to be higher near the application area and lower at greater distances if the surface roughness in the area is relatively high (above 1 meter, such as in forested areas). Therefore, overestimation of the surface roughness could overpredict deposition within about 50 km of the application area and underpredict deposition beyond 50 km. Overestimation of the surface roughness could occur if, for example, prescribed burning was used to treat a typically forested area prior to planned herbicide treatment.

The surface roughness also affects the calculated "friction velocity" used to determine deposition velocities, which in turn are used by CALPUFF to calculate the deposition rate. Friction velocity increases with increasing wind speed and increasing surface roughness. Higher friction velocities result in higher deposition velocities and higher deposition rates, particularly within about 50 km (30 miles) of the emission source.

The CALPUFF modeling assumes that the data from the selected National Weather Service stations is representative of meteorological conditions in the vicinity of the application sites. Site-specific meteorological data (e.g., from an on-site meteorological tower) could provide slightly different wind patterns, possibly due to local terrain, which could impact the deposition rates as well as locations of maximum deposition.

Overall, conservative assumptions employed in exposure characterization will tend to overestimate risk, and therefore, may provide a buffer for the effects of uncertainties.

Potential Indirect Effects on Salmonids

No actual field studies or ecological incident reports on the effects of the 10 herbicides on salmonids were identified during the ERA. Therefore, any discussion of direct or indirect impacts on salmonids was limited to qualitative estimates of potential impacts on salmonid populations and communities. In some herbicide evaluations TRVs are based on warmwater

species because these have the highest risk, and this may result in an overestimate of risks to salmonids, which are coldwater species. These evaluations indicated that for most herbicides (except diuron, diquat, and fluridone), salmonids are not likely to be indirectly impacted by a reduction in food supply (i.e., fish and aquatic invertebrates). However, they could be affected by a reduction in vegetative cover, which may occur under some conditions.

It is anticipated that these qualitative evaluations overestimate the potential risk to salmonids because of the conservative selection of TRVs for salmonid prey and vegetative cover, the application of additional LOCs (with uncertainty/safety factors applied) to assess risk to RTE species, and the use of conservative stream characteristics in the exposure scenarios (i.e., low order stream, relatively small instantaneous volume, limited consideration of herbicide degradation or absorption in models).

Herbicide Application Recommendations

The following general recommendations are designed to reduce potential unintended impacts to the environment from the application of herbicides in the BLM vegetation management program (see the individual ERAs for recommendations specific to each herbicide):

- Select herbicide products carefully to minimize additional impacts from degradates, adjuvants, inert ingredients, and tank mixtures. This is especially important for application scenarios that already predict potential risk from the a.i. itself.
- Review, understand, and conform to the “Environmental Hazards” section on the herbicide label. This section warns of known pesticide risks to wildlife receptors or to the environment and provides practical ways to avoid harm to organisms or to the environment.
- Avoid accidental direct spray and spill conditions to reduce the largest potential impacts. Use the typical application rate, rather than the maximum application rate, to reduce risk to most species for most herbicides.
- Limit the use of terrestrial herbicides (especially bromacil, diuron, and sulfometuron methyl) in watersheds with downgradient ponds and streams if potential impacts to aquatic plants are of concern.
- Establish appropriate (herbicide specific) buffer zones to downstream waterbodies, habitats, or species/populations of interest (see Table C-16).
- Consider the proximity of application areas to salmonid habitat and the possible effects of herbicides on riparian and aquatic vegetation. Maintain appropriate buffer zones around salmonid-bearing streams (see Table C-16 and recommendations in individual ERAs).
- The results from these ERAs contribute to the evaluation of proposed alternatives in the PEIS and to the development of the Biological Assessment (BA), specifically addressing the potential impacts of vegetation treatments to proposed and listed RTE species on public lands. Furthermore, the ERAs will assist BLM field offices on the proper application of herbicides to ensure that impacts to plants and animals and their habitats are minimized to the extent practical.

TABLE C-16
Buffer Distances to Minimize Risk from Off-site Drift of Herbicides

Application Scenario	BROM	CHLR	DIFLU	DIQT	DIUR	FLUR	IMAZ	OVER	SULF	TEBU
Buffer Distance (feet) from Non-target Aquatic Areas										
Typical Application Rate										
Aerial	NA	0	NA	NE	NA	NE	0	NA	1,300	NE
Low Boom	100	0	100	NE	900	NE	0	100	900	0
High Boom	900	0	900	NE	1,000	NE	0	900	900	0
Maximum Application Rate										
Aerial	NA	300	NA	NE	NA	NE	300	NA	1,500	NE
Low Boom	900	0	900	NE	1,000	NE	0	900	900	0
High Boom	900	0	900	NE	1,000	NE	0	900	900	0
Buffer Distance (feet) from Non-target Terrestrial Plants										
Typical Application Rate										
Aerial	NA	1,350	NA	1,200	NA	NE	0	NA	0	NE
Low Boom	950	900	100	100	0	NE	0	0	0	0
High Boom	950	900	100	900	100	NE	0	100	0	0
Maximum Application Rate										
Aerial	NA	1,350	NA	1,200	NA	NE	900	NA	0	NE
Low Boom	1,000	1,000	100	900	200	NE	0	100	0	50
High Boom	1,000	1,000	100	900	500	NE	0	100	0	50
Buffer Distance (feet) from Rare, Threatened, and Endangered Terrestrial Plants										
Typical Application Rate										
Aerial	NA	1,400	NA	1,200	NA	NE	300	NA	1,500	NE
Low Boom	1,200	1,000	100	900	1,000	NE	0	100	1,100	0
High Boom	1,200	1,000	900	900	1,000	NE	0	900	1,100	50
Maximum Application Rate										
Aerial	NA	1,400	NA	1,200	NA	NE	900	NA	1,500	NE
Low Boom	1,200	1,050	900	1,000	1,000	NE	0	900	1,100	100
High Boom	1,200	1,000	900	1,000	1,000	NE	0	900	1,100	500

Buffer distances are the smallest modeled distance at which no risk was predicted. In some cases, buffer distances were extrapolated (if the largest distance modeled still resulted in risk) or interpolated (if greater precision was required).
NA = Not applicable; NE = Not evaluated; BROM = Bromacil; CHRL = Chlorsulfuron; DIFLU = Diflufenzopyr; DIQT = Diquat; DIUR = Diuron; FLUR = Fluridone; IMAZ = Imazapic; OVER = Overdrive®; SULF = Sulfometuron methyl; and TEBU = Tebuthiuron.

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APPENDIX D

PROTOCOL FOR IDENTIFYING, EVALUATING, AND USING NEW HERBICIDES

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APPENDIX D

PROTOCOL FOR IDENTIFYING, EVALUATING, AND USING NEW HERBICIDES

The BLM may become aware of new herbicide products and technologies that may be developed and marketed and may consider application of these products or technologies in vegetation treatment projects. This appendix discusses the procedures the BLM would follow if an alternative is identified in the Record of Decision that allows the BLM to use new herbicides in the future.

Identification and Approval of New Chemical Products and Technologies

The general mechanisms through which the BLM could learn of new products and their applications include, but are not limited to professional networking, technical research and publications, and vendor marketing.

Networking

Participation in professional networks is an important method for staying current on new herbicides, and yields information on the technical, regulatory, efficacy, and environmental aspects of herbicide products, both those in the development phase and those currently on the market. The primary professional associations that BLM land managers participate in and network with include, but are not limited to:

- U.S. Environmental Protection Agency Office of Pesticide Programs
- U.S. Fish and Wildlife Service
- National Oceanic and Atmospheric Administration Fisheries Service Fisheries
- U.S. Department of Agriculture Agricultural Research Service
- Natural Resources Conservation Service
- Weed Science Society of America
- Western Society of Weed Science
- Society for Range Management
- State pest control associations
- State departments of agriculture
- Universities and colleges
- University extension services
- County conservation districts
- County weed districts.

For the most part, networking occurs at the local level with BLM professional staff and managers working with local representatives of the organizations mentioned above. BLM state weed coordinators and vegetation management professionals often represent the agency at annual meetings and workshops. BLM Washington Office managers and staff network at national and international level annual meetings, as well as sponsor and attend regional and local meetings and workshops. Field trips to treatment demonstration areas are an important component of networking.

Technical Research and Publications

Aside from the professional journals associated with different vegetation management societies and associations, the BLM obtains information on vegetation management and herbicide treatment herbicides from the following: USDA Agricultural Research Service research publications, university research summaries, cooperative extension service publications, USEPA registration data, toxicological and risk assessment studies, literature summaries, and technical databases. Databases and technical sources consulted by the BLM include: AGRICOLA, ASFA (Aquatic Sciences and Fisheries Abstracts), Biological Sciences, BIOSIS/Biological Abstracts, Chemical Abstracts/Scifinder Scholar, Environmental Science and Pollution Management, MedLine, Safety Science and Risk, Toxline, Water Resources Abstracts, Web of Science/Science Citation Index, and Zoological

Records. The public and non-governmental organizations also provide the BLM with information through the National Environmental Policy Act (NEPA) process and other participatory processes.

Vendor Marketing

Vendors of invasive plant control technologies, including agrochemical company representatives, contact the BLM to introduce new active ingredients and new formulations and provide updates on existing products. These contacts may come in the form of mailed brochures or advertisements, telephone contacts, or personal visits. Companies may sponsor seminars in local cities and towns to promote and educate local, county, state, and federal professionals in the area on the safe use of products and technologies.

From time to time, members of the public who are interested in various approaches to vegetation treatment send information to the BLM describing such approaches. As with vegetation treatment methods identified through other avenues, if the BLM determines that the approach may have some utility for meeting its needs, a product demonstration or additional information may be requested.

Determining the Need for New Herbicides

In order for the BLM to consider and approve a new active ingredient or formulation, the BLM must first consider whether there is a need for an available product. Factors that would be considered when assessing the need for adopting an available product include, but are not limited to: spectrum of application, efficacy, factors that could limit efficacy, extent or scope of use, cost, availability, availability of substitute or alternative products or technologies, expected effectiveness compared to any currently used methods, previous use reports at other sites and their outcomes, training and personnel requirements, and any other relevant factors (including hazards and risks). Once a need was determined, the BLM would then integrate the approval process with its annual budget cycle. In general, the approval/budget process should take approximately 2 fiscal years to complete once a need for an available product is identified (see Figure D-1).

The determination for the need is a "bottom up" process that would typically start with the BLM field office collecting information regarding the need to: 1) add a new active ingredient to the BLM list of approved active ingredients; 2) modify existing labels (e.g., add aerial applications to a label); or 3) identify new active ingredients through contacts within the local research community. Once the BLM field office determined a need, it would provide a summary and request as an attachment to its end-of-year (EOY) pesticide use report.

Once the request was made, it would then go to the state weed or pesticide coordinator who would review the request and any other requests received. The state weed or pesticide coordinator would then screen the suggestions and requests, clarify any information required, submit additional requests and suggestions identified throughout the year by other sources, and provide a single summary request to the BLM Washington, D.C., office when submitting its annual state-wide pesticide use report.

Before an herbicide active ingredient was proposed for consideration by the BLM field or state office, it would have a completed USEPA Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) registration in place and be labeled for use on the site proposed (e.g. rangeland, pasture, non-cropland, aquatic habitat). The BLM would not consider any active ingredients in its review and approval process for products proposed to be registered or in the registration process before the FIFRA registration process was complete.

Proposals and suggestions would be received and reviewed by the BLM Washington, D.C., office. Specialists involved in this review would include the senior weed specialist, integrated pest management specialist, rangeland specialist, and others who may have an interest in the determination to be made. This group would determine whether the new active ingredient being proposed is one that would benefit the BLM, or if the benefit would be so limited in scope that the cost to proceed would not be justified. This group would also determine whether a proposed label modification would benefit the entire BLM. Once the proposals and suggestions had been reviewed, final recommendations would be forwarded by the Rangeland Group Manager to the Assistant Director for Renewable Resources and Planning for inclusion into following fiscal year's budget process to conduct risk assessments.

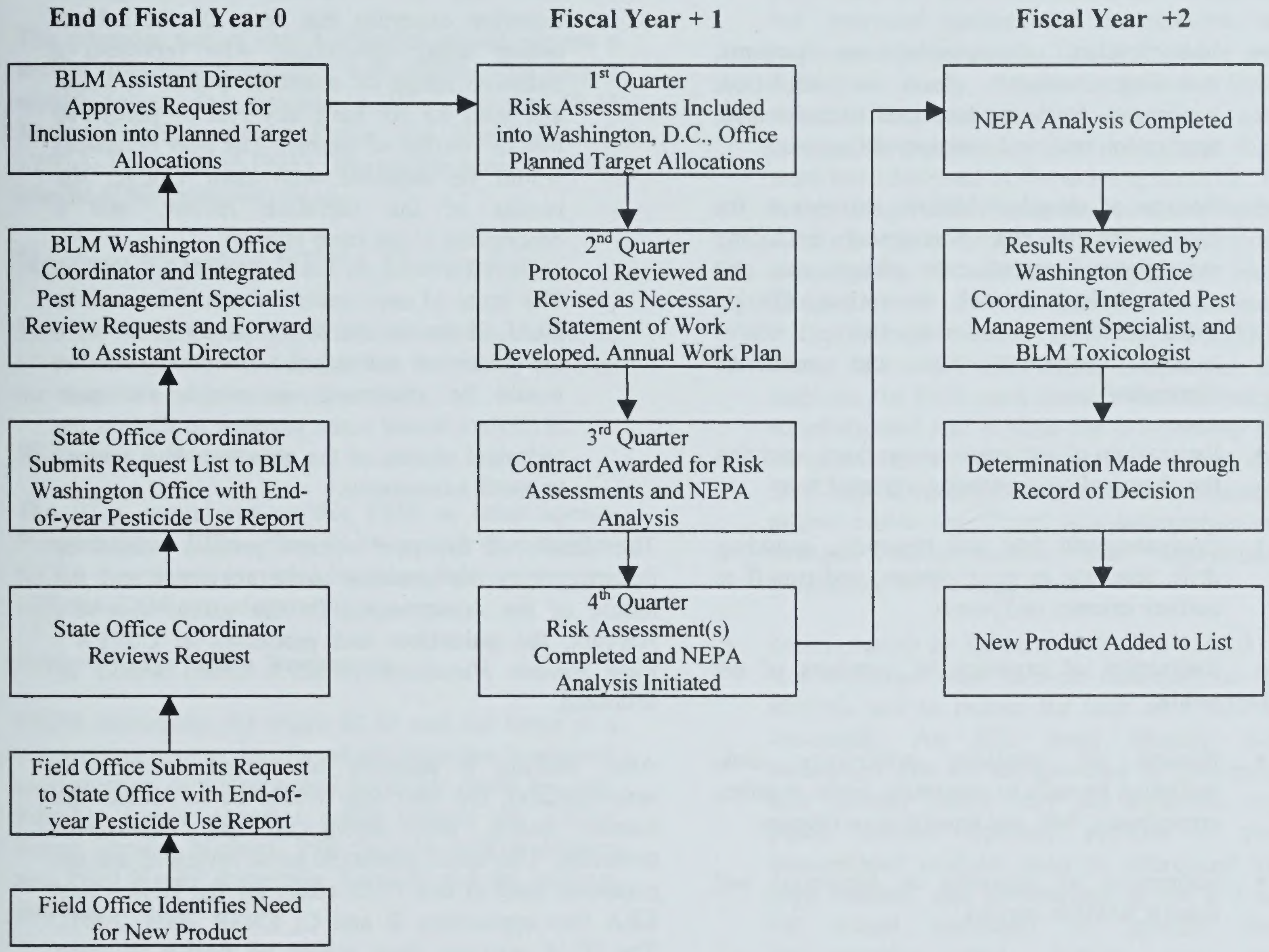


Figure D-1. New Herbicide Evaluation and Approval Process.

Assessment of Hazards and Risks

Any new herbicide considered for use by the BLM must be registered under FIFRA, which requires product performance data relating to its effectiveness. This requirement was designed "to ensure that pesticide products will control the pests listed on the label and that unnecessary pesticide exposure to the environment will not occur as a result of the use of ineffective products" (40 Code of Federal Regulations [CFR] 158.202[i]). Therefore, any new pesticide registered under FIFRA is expected to be generally effective for the labeled uses. To further assess the potential for site-specific effectiveness prior to an actual application in the field, the BLM field office manager would investigate its use through professional networks, technical publications, and research reports, such as those described in the previous section.

As stated above, the BLM only uses herbicide products that are registered by the USEPA under FIFRA. Therefore, for any herbicide considered for use on public lands, a body of USEPA-reviewed toxicological, environmental fate, and ecotoxicity data, submitted by the pesticide manufacturer to support its registration application, would be available for review, especially for new active ingredients. Active ingredients for products undergoing re-registration could have less data available if the original registration package did not include extensive ecological toxicology data. These data could then be used to conduct an assessment of the potential human health and ecological risks from the herbicide's use,

including, but not limited to, the following components:

- Identification of potential use patterns, including target plants, formulation, application methods, locations to be treated, application rate, and anticipated frequency
- Review of chemical hazards relevant to the human health risk assessment, including systemic and reproductive effects, skin and eye irritation, dermal absorption, allergic hypersensitivity, carcinogenicity, neuro-toxicity, immunotoxicity, and endocrine disruption
- Estimation of exposure to workers applying the chemical or re-entering a treated area
- Environmental fate and transport, including drift, leaching to groundwater, and runoff to surface streams and ponds
- Estimation of exposure to members of the public
- Review of available ecotoxicity data, including hazards to mammals, birds, reptiles, amphibians, fish, and aquatic invertebrates
- Estimation of exposure to terrestrial and aquatic wildlife species
- Characterization of risk to human health and wildlife

If the available toxicity or ecotoxicity data were inconclusive, or substantial disagreement should occur among the results of technical studies that could affect the potential risk conclusions for the chemical, the BLM would conduct a formal peer review of the available scientific information to develop a consensus as to the endpoint(s) in question. The peer review process would include the following steps, based largely on USEPA's peer review process (USEPA 2000):

- The BLM would conduct a literature search of studies submitted to the USEPA, studies published in professional journals, and research projects conducted by other government agencies or universities. The identified literature would be indexed and abstracted.
- A peer review committee would be formed, consisting of reviewers with recognized technical expertise that bears on the subject matter under discussion, who represent a balanced range of scientific points of view, and who do not have any real or perceived bias or conflict of interest. The peer reviewers would be supplied with their charge, the results of the literature review, and a description of the issue at hand.
- The input of each reviewer would be sent to BLM. If the results of the peer review were not consistent at this point, a working session would be convened, in which the peer reviewers would come together to discuss the technical aspects of the questions and attempt to reach a consensus.

The details of the peer review process would be determined by the question to be answered and the nature of the controversy. To the extent they are relevant, the guidelines and processes in USEPA's *Peer Review Handbook* (USEPA 2000) would be followed.

After making a decision to budget for a risk assessment(s), the next step would be to review the human health and ecological risk assessment protocols. The initial protocols to be reviewed are the protocols used in this PEIS effort for the HHRA and ERA (see appendices B and C; ENSR 2004, 2005). The BLM assumes there would be further research conducted on a continuing and ongoing basis, and environmental standards and end-points would change over time, as the science was refined. There would be regulatory changes, as well, to keep pace with new information. Therefore, it is required that the risk assessment protocols be reviewed by the BLM to ensure they reflect the best science available and current standards for environmental review at the time the risk assessments are conducted. If there was new information, or changes to environmental standards were identified, then the protocols would be revised as required to meet the new standards prior to conducting additional risk assessments, whether for new active ingredients or new risk assessments for previously-approved active ingredients. Standards for literature review in the protocols would also be reviewed and updated as necessary to ensure that all ecotoxicological literature available was identified prior to conducting a risk assessment.

NEPA Documentation

The potential use of new herbicides would require a review to ensure compliance with NEPA. The review would follow the process outlined in the BLM *National Environmental Policy Act Handbook* (H-1790-1; USDI BLM 1988). The review process would consist of the following steps.

Review Existing NEPA Documents

The following types of NEPA documents would be reviewed to determine whether any have fully covered the use of the proposed new herbicide:

BLM NEPA Documents

The BLM would review this PEIS or other agency Programmatic EISs. The BLM would also review NEPA documents prepared by other federal agencies, with the BLM as a cooperating agency

Other Agency NEPA Documents

NEPA documents for which BLM was not listed as a cooperating agency, but for which the scope is relevant to evaluation of the proposed herbicide could be used. Possible source agencies could include the USDA Forest Service, National Park Service, USDA Animal and Plant Health Inspection Service, and the military services.

Depending on the outcome of the review, it might be appropriate to tier to, supplement, or incorporate by reference parts or all of existing document(s) as part of the document preparation process:

- *Tiering* (40 CFR 1508.28) could be used to prepare new more specific or more narrow environmental documents without duplicating relevant parts of previously prepared, more general or broader documents (such as this PEIS). Tiering is mostly used to avoid unnecessary paperwork. Documents can be tiered only if decisions made in the new document would not change or modify the decision(s) of the more general document.

- *Supplementing* (40 CFR 1502.9c) is most often used to address alternatives not previously analyzed and may lead to a new decision. In this instance, a supplemental EIS (SEIS) to this PEIS could be prepared. Supplemental documents are generally prepared when there is a substantial change in the proposed action that is relevant to environmental concerns; that is, if there are significant new circumstances or facts relevant to environmental concerns and bearing on proposed action or impacts that were not addressed in the existing analysis. If the existing PEIS is supplemented, the same standard procedural and documentation requirements for EISs are followed (see Chapter 5 of the *National Environmental Policy Act Handbook*; USDI BLM 1988), except that additional scoping is optional. In addition, the SEIS must identify the EIS being supplemented and explain the relationship to the prior analysis early in the text. Further, the SEIS should identify changes in the proposed project and/or significant new information or changed circumstances that necessitate preparation of the supplement.

- *Incorporating by reference* (40 CFR 1502.21) is a technique used to avoid redundancies in analysis and to reduce the bulk of a NEPA document. An EIS must identify the documents that are incorporated by reference and indicate where they are available for public review. Relevant portions of the incorporated analysis must be referenced by page number, and summarized in the EIS to the extent necessary to provide the decisionmaker and public with an understanding of significance of the referenced material to the current analysis. The new NEPA document must be able to stand alone.

If existing NEPA documentation was found to be adequate, but the BLM was not formally a cooperating agency on the document, then the BLM would adopt the document to comply with NEPA; adoption would be in accordance with the requirements set forth in 40 CFR 1506.3.

If existing NEPA documentation was determined to be inadequate, a new NEPA document would be prepared.

Prepare a New NEPA Document

The process for complying with NEPA for proposals to approve the use of new active ingredients on BLM

public lands differs from the standard NEPA screening process for other federal actions. For example, neither the USDI nor the BLM have categorical exclusions ("a category of [federal] actions that does not individually or cumulatively have a significant effect on the human environment...for which, therefore, neither an EA nor an EIS is required;" 40 CFR 1508.4) that address the use of herbicides; therefore, this step does not apply. The BLM, through this and previous EISs, has already determined that approval of herbicides for future use on public lands is a controversial federal action significantly affecting the human environment. Therefore, it is inappropriate to use an EA and Finding of No Significant Impact (FONSI) for such approval. This is not to say a particular project involving the use of herbicides could not be assessed with an EA level analysis, properly tiered to a land use plan EIS or other NEPA document. This determination of significance only applies to the approval of a new active ingredient for use by BLM overall. Site-specific impacts for any project using herbicides would be assessed at a level appropriate for the project, using the standards for "Significantly" found under 40 CFR 1508.27.

Initially, the BLM would use this PEIS as its basis for conducting future risk assessments and approvals. Following the guidance under 40 CFR 1502.9 (4) Draft, final and supplemental statements, the BLM would conduct risk assessments on new active ingredients and build on the analysis contained in this PEIS through the issuance of a Supplemental EIS (SEIS) and a final decision on whether an active ingredient was approved would be recorded in a Record of Decision. Supplemental EISs would be utilized for approvals of new active ingredients until such time as the need for a new programmatic EIS was warranted and such a document was prepared. For cost efficiency, it is recommended that BLM assess several active ingredients together in one Supplemental EIS.

References

ENSR. 2004. Vegetation Treatments Programmatic EIS Ecological Risk Assessment Protocol. Report Prepared for the Bureau of Land Management, Reno, Nevada. Westford, Massachusetts.

ENSR. 2005. Human Health Risk Assessment Final Report. Report Prepared for the Bureau of Land Management, Reno, Nevada. Westford, Massachusetts.

U. S. Department of the Interior Bureau of Land Management (USDI BLM). 1988. National Environmental Policy Act Handbook. Bureau of Land Management Handbook H-1790-1. Washington, D.C.

U.S. Environmental Protection Agency (USEPA). 2000. Peer Review Handbook. 2nd Edition. Washington, D.C. Available at: http://www.epa.gov/osp/spc/prhandbk.pdf.

References

[illegible]

APPENDIX E

MANUALS AND HANDBOOKS

APPENDIX E

REFERENCE MANUALS AND HANDBOOKS

General and specific program direction, such as policy, required procedures, and standards concerning the use of renewable resource improvements are contained in a number of BLM Manual Sections and Handbooks. The following list of references provides a general index to this information for use by BLM managerial and staff personnel. A complete listing of all BLM Section Codes can be found in Appendix 3, pages 93-168 in BLM Manual Section 1220 Records and Information Management and is available at: http://www.blm.gov/nhp/efoia/wo/manual/1220.pdf.

Manual Section 1112	Safety
Manual Section 1510	Procurement
Manual Section 1601	Bureau Planning System
Handbook H-1601-1	Land Use Planning Handbook
Manual Section1616	Prescribed Resource Management Planning Actions
Manual Section 1617	Resource Management Plan Approval, Use, and Modification
Manual Section 1619	Activity Plan Coordination
Manual Sections 1620-1625	Supplemental Program Guidance
Manual Section 1740	Renewable Resource Improvements and Treatments
Handbook H-1740-1	Renewable Resource Improvement and Treatment Guidelines and Procedures
Manual Section 1741	Renewable Resource Improvements, Practices, and Standards
Handbook H-1741-1	Fencing
Handbook H-1741-2	Water Developments
Manual Section 1742	Emergency Fire Rehabilitation
Handbook H-1742-1	Emergency Fire Rehabilitation
Manual Section 1743	Renewable Resource Investment Analysis
Handbook H-1743-1	Resource Investment Analysis: User Handbook for the SageRam Computer Program
Handbook H-1790-1	National Environmental Policy Act Handbook
Manual Section 2920	Leases, Permits, and Easements
Manual Section 4010	Range Management Program Records
Handbook H-4010-1	Range Management Program Records
Manual Section 4100	Grazing Administration – Exclusive of Alaska
Manual Section 4120	Grazing Management
Handbook H-4120-1	Grazing Management
Manual Section 4180	Rangeland Health Standards
Handbook H-4180-1	Rangeland Health Standards
Manual Section 4400	Rangeland Inventory, Monitoring, and Evaluation
Handbook H-4400-1	Rangeland, Inventory, Monitoring, and Evaluation
Handbook H-4410-1	National Range Handbook

Manual Section 5000	Forest Management
Manual Section 5400	Sales of Forest Products
Handbook H-6310-1	Wilderness Inventory and Study Procedures
Manual Section 6500	Wildlife and Fisheries Management
Manual Section 6780	Habitat Management Plans
Manual Section 6840	Special Status Species Management
Manual Section 7000	Soil, Water, and Air Management
Manual Section 8100	the Foundations for Managing Cultural Resources
Manual Section 8110	Identifying and Evaluating Cultural Resources
Manual Section 8120	Tribal Consultation under Cultural Resources Authorities
Handbook H-8120-1	General Procedural Guidance for Native American Consultation
Manual Section 8130	Planning for Uses of Cultural Resources
Manual Section 8140	Protecting Cultural Resources
Manual Section 8150	Permitting Uses of Cultural Resources
Handbook H-8160-1	General Procedural Guidelines for Native American Consultation
Manual Section 8170	Interpreting Cultural Resources for the Public
Manual Section 8270	Paleontological Resource Management
Handbook H-8270-1	General Procedural Guidance for Paleontological Resource Management
Manual Section 8351	Wild and Scenic Rivers – Policy and Program Direction for Identification, Evaluation, and Management
Manual Section 8400	Visual Resource Management
Handbook H-8410-1	Visual Resource Inventory
Manual Section 8431	Visual Resource Contrast Rating
Handbook H-8550-1	Interim Management Policy for Lands under Wilderness Review
Manual Section 8560	Management of Designated Wilderness Areas
Handbook H-8560-1	Wilderness Management
Manual Section 8720	Paleontological Resource Management
Manual Section 9011	Chemical Pest Control
Handbook H-9011-1	Chemical Pest Control
Manual Section 9012	Expenditure of Rangeland Insect Pest Control Funds
Manual Section 9014	Use of Biological Control Agents of Pest on Public Lands
Manual Section 9015	Integrated Weed Management
Manual Section 9100	Engineering
Manual Section 9101	Facility Planning
Manual Section 9102	Facility Design
Manual Section 9103	Facility Construction
Manual Section 9104	Facility Maintenance
Manual Section 9114	Trails
Manual Section 9132	Operational Signs
Manual Section 9172	Water Control Structures
Handbook H-9172-1	Water Control Structures—Guidelines for Design
Handbook H-9172-2	Water Control Structures—Guidelines for Construction Drawings
Manual Section 9177	Maintenance and Safety of Dams

Handbook H-9177-1	Performing Condition Surveys for Earth Embankment Dams
Handbook H-9177-2	Performing Emergency Action Plans
Handbook H-9177-3	Reporting Dam Failures
Manual Section 9182	Wastewater Treatment
Manual Section 9183	Municipal—Community Related Solid Waste
Manual Section 9184	Drinking Water Supply
Manual Section 9210	Fire Management
Manual Section 9211	Fire Planning
Handbook H-9211-1	Fire Management Activity Planning Procedures
Manual Section 9214	Prescribed Fire Management
Handbook H-9214-1	Prescribed Fire Management
Manual Section 9215	Fire Training and Qualifications
Manual Section 9218	Fire Reporting and Statistics
Manual Section 9220	Integrated Pest Management

APPENDIX F

TRIBAL AND AGENCY CONSULTATION

TRIBAL CONSULTATION

7/26/02

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Washington, D.C. 20240
http://www.blm.gov

July 3, 2002

RE: Bureau of Land Management (BLM) Vegetation Treatments Programmatic Environmental Impact Statement (EIS) for the Western U.S., Including Alaska

Dear Chairperson:

The Bureau of Land Management (BLM) is preparing a programmatic EIS to evaluate the impacts of the vegetative treatments on the environment and local economies. The BLM is proposing to treat vegetation on approximately six million acres annually in the western U.S., and Alaska. The purpose of these treatments is to conserve and restore the function of vegetation, watershed, and fish and wildlife habitat. Vegetation treatment methods could include mechanical, manual, chemical, biological, and cultural control, as well as prescribed fires. Cultural control utilizes goats and other animlas.

Approximately half the acres would be treated to restore historic fire regimes and to reduce the risk of wildfires on BLM-administered lands. The BLM estimated that 1-1-½ million acres of wildfire-damaged land would be treated annually under the Emergency Stabilization and Rehabilitation program. The BLM would manage the rest of the acreage under several programs, including the control of noxious weeds, invasive plants, and the restoration of damaged lands by seeding and replanting.

As part of the program, the BLM is proposing to evaluate five new herbicides for possible use on public lands in the EIS. We are currently assessing risk to humans, fish, and wildlife from use of these chemicals. In addition, BLM will develop a protocol as part of the EIS which will allow us to streamline the process of evaluation and approval of herbicides that may be developed in the future.

The vegetation treatment actions would occur on public lands administered by the BLM in Alaska, Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Texas, Washington, and Wyoming. The enclosed sheet titled "Frequently Asked Questions" discusses the vegetation treatment's program and the EIS, and the enclosed map shows the locations of BLM-administered lands in your State.

The programmatic EIS is designed to look at the broad impacts associated with the design to implement the vegetation treatment program. Because the program covers such a large area, assessing site-specific impacts in this EIS is not realistic. This approach will allow the future development of more site-specific National Environmental Policy Act documents, such as land-use plans and project-specific analysis. The need for repetitive discussion of the same issues in the site-specific documents will be eliminated.

The BLM is coordinating closely with other Federal, State, and local agencies, Native American Tribes, Alaska Native groups, and other stakeholders. The BLM recently completed public scoping and is in the process of reviewing comments and identifying alternative treatment actions to the proposed action. We anticipate that the Draft EIS will be completed later this fall.

The BLM seeks to address the effects of treatment methods on resources used by Native Americans and Alaska Native groups. We ask that you review the enclosed materials and inform us of any concerns you might have about any of the proposed vegetation treatments. We are particularly interested in potential impacts on subsistence plants and animals, and on traditional cultural properties. We are also interested in potential impacts on resources associated with reserved rights under treaty, where they exist. Could you tell us which of the treatment activities are of further concern to you? Please let us know whether you would like to provide information and if you would like to participate in the environmental process by receiving review copies of the documents that we produce. Continued consultation with the affected Indian Tribes and Alaska Native groups will occur during the development and implementation of special projects by BLM field offices. We will keep you informed as to the progress of the project. You may also visit the BLM website to learn more about the project: http://www.blm.gov/weeds/VegEIS/index.htm.

Thank you for your time and consideration of this request. We would appreciate your response within 30 days. If you have any questions, concerns, or would like additional information, please contact Gina Ramos, co-team lead at 202-452-4084 or Brian Amme, Project Manager at 775-861-6645.

Sincerely,

Assistant Director, Renewable Resources
and Planning

2 Enclosures
1 - Frequently Asked Questions
2 - Project Area Map

BUREAU OF LAND MANAGEMENT

VEGETATION TREATMENTS PROGRAMMATIC EIS FOR THE WESTERN U.S. AND ALASKA

Frequently Asked Questions

Project Description

Q. What is the Bureau of Land Management (BLM) proposing to do?
A. The BLM is proposing to treat soil and vegetation on an estimated 6 million acres annually in the western U.S. and Alaska. The purpose of these treatments would be to conserve and restore vegetation, fish and wildlife habitat, and watershed functions using several treatment methods. Mechanical, manual, chemical, biological, and cultural (use of goats and other animals) treatment methods, and prescribed fire, would be used to treat vegetation.

Over half of the acres would be treated to restore historic fire regimes and reduce the risk of wildfire on BLM-administered lands. An estimated one million acres damaged by wildfires would be treated annually under the Emergency Stabilization and Rehabilitation Program. The remaining acreage would be managed under several BLM programs, and management would primarily involve the control of noxious weeds and invasive plants, and the restoration of damaged lands by seeding and replanting.

In addition, the BLM may be allowed to use several proposed herbicides that will be evaluated in the EIS, as well as new chemicals that may be developed in the future.

Q. Where would the proposed actions occur?
A. The vegetation treatment actions would occur on public lands administered by the BLM in the western U.S. and Alaska. The majority of these lands are in Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

Q. Will the EIS include National Monuments and National Conservation Areas?
A. Yes, since they are included in the project area. These units will be analyzed as part of the broad programmatic treatment area to the extent that conservation and restoration project work, including invasive and noxious weed treatments, are allowed by the individual National Landscape Conservation System proclamations.

Q. How is this project different from what the BLM is already doing?
A. The BLM is currently authorized under earlier National Environmental Policy Act (NEPA) programmatic EISs to treat vegetation on approximately 500,000 acres in the western U.S.; however, Alaska was not included in the analyses in these EISs. Under the proposed program, the BLM would be able to treat several million more acres annually, and treatment activities in Alaska would also be covered under this EIS.

Q. Why does the BLM need to treat several million more acres annually?
A. Numerous large wildfires in the west in recent years have made it imperative that wildfire fuels be reduced to decrease the potential for future catastrophic wildfires. Over half of the acres would be treated to restore historic fire regimes and to reduce risk of wildfire on BLM-administered lands, especially those near urban areas. Over a million acres of lands burned by wildfires would be restored annually by seeding and planting. The remaining acres would be treated under several BLM programs, and management would primarily involve the control of noxious weeds and invasive plants.

EIS Development Process

Q. Why is the BLM developing this EIS?
A. The BLM is preparing a programmatic EIS to evaluate the impacts of treatments for the conservation and restoration of vegetation, watershed, and fish and wildlife habitat on surface lands administered by the BLM in the western U.S., including Alaska. The BLM is developing the EIS to update and replace analyses contained in four existing vegetation treatment EISs that were completed between 1986 and 1992. These documents are becoming less useful because new information is now available, and conditions and circumstances influencing treatment requirements have changed. For example, several new fire initiatives, including the National Fire Plan, Integrated Weed Management Plan, and Great Basin Restoration Initiative, have identified a need to do more vegetative treatments across the landscape to reduce the risks of wildfires and to control noxious weeds. The EIS is also being developed to analyze similar activities on BLM-administered lands in Alaska, which were not included in the earlier EISs.

Q. What is the purpose of the EIS?
A. The EIS will: (1) provide a comprehensive analysis of BLM conservation and restoration activities involving the treatment, modification, or restoration of vegetation, fish and wildlife habitat, and watersheds; (2) provide a comprehensive programmatic NEPA document for use by local BLM field offices for local land-use planning; (3) serve as a baseline cumulative impact assessment; (4) assess human and environmental health risks from proposed new herbicides and prescribed burning activities; and (5) consider state-specific activities, including hazardous fuels treatments, to protect communities and restore desired natural fire regimes.

Q. Is the EIS a land-use plan?
A. No, the EIS is neither a land-use plan nor an amendment to a land-use plan. As a programmatic EIS, it will not determine land use on the public lands and will not address specific agency management decisions developed under local land use plans.

Q. What is the difference between a programmatic EIS and project-specific EIS?
A. A programmatic EIS is designed to look at the broad, generic impacts associated with a decision to fully implement a program. Because this EIS covers vegetation treatment activities on 15 states, it is not realistically possible to assess site-specific impacts associated with the program. A programmatic EIS also allows for the tiering of more site-specific NEPA documents, such as land-use plans, eliminating the need for repetitive discussions of the same issues. A project-specific EIS looks at impacts associated with a site-specific project, such as vegetation treatment activities on 1,000 acres of BLM-administered lands.

Q. How will this EIS affect current and future local land-use plans?
A. There should be little effect on current land-use plans. However, the programmatic EIS should minimize the need for cumulative impact documentation in future individual land-use plans, revisions, amendments, and EISs. The EIS will act as an umbrella document under which the local field offices can develop local land-use plans by providing comprehensive general guidelines, and will serve as a baseline cumulative impact assessment.

Q. Who is developing the EIS?
A. The BLM Office of Rangelands, Soils, Water and Air in Washington, D.C., is leading the project, supported by BLM technical resource specialists in BLM offices throughout the western U.S. and Alaska. ENSR International, a third-party contractor, will conduct the public meetings and prepare the EIS in accordance with BLM guidelines and oversight.

Q. Are there any other federal agencies involved in the effort?
A. There are no other federal agencies involved as cooperating agencies; however, the project is being closely coordinated with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and Environmental Protection Agency.

Q. Are tribal, state, and local governments involved in the EIS process?
A. The BLM will coordinate closely with tribal, state, and local governments, the National Association of Counties, and the Western Governors Association throughout development of the EIS.

Q. How much has been done so far, and what is the next step?
A. The Notice of Intent to develop the EIS was published in the Federal Register on October 12, 2001, and a news release was distributed to the media, interested groups, and state agencies by the BLM at the same time. A notice of the extension of the public comment period and the schedule for scoping meetings was published in the Federal Register on January 2, 2002, and a "Questions and Answers" information sheet was distributed on the same date. Nineteen public scoping meetings will be held throughout the western U.S., and in Alaska and Washington, D.C., during January through mid March.

Q. When is the EIS scheduled for completion?
A. The Draft EIS is scheduled to be completed in the fall of 2002, and the Final EIS in late summer 2003.

Potential Issues to Be Examined in the EIS

Q. Does this EIS involve controversial issues?
A. It is anticipated that most public scrutiny will focus on issues associated with the use of prescribed fire and restoration of fire-adapted ecosystems, and the use of herbicides to control noxious weeds and other vegetation. Specific issues to be addressed in the EIS include the impacts of wildfires and prescribed fires on regional air quality; effects of herbicides on human and environmental health; effects of treatment methods on threatened and endangered species; and effects of treatment methods on resources used by Native Americans and Alaska Native groups.

Q. What issues will this EIS not cover?
A. The EIS will not address vegetation management that is primarily focused on commercial timber or other forest product enhancement and use, livestock forage enhancement and use, abandoned mine land reclamation, and energy production. The EIS will not analyze fire suppression operations and soil stabilization, except where related to vegetation treatment. The EIS also will not make land use allocations, or evaluate off-road vehicle use of BLM-administered lands.

Q. Will there be an assessment of risks to the public and the environment from the use of herbicides and prescribed burning?
A. A risk assessment will be done to determine the likely risks to humans and wildlife from the treatments involving new herbicides proposed for use by the BLM, and from prescribed burning. The EIS will not evaluate the risks from herbicides presently being used by the BLM, which have already been evaluated in the earlier EISs, unless new information has become available to suggest that these herbicides require further evaluation.

Q. Will the EIS include alternatives for treating vegetation and mitigation?
A. Yes, the EIS will include alternative proposals for treating vegetation, including the use of preventive measures and operational procedures to reduce impacts to humans and the environment.

Q. Will there be a process developed to determine which new chemicals the BLM can use to control vegetation?
A. Yes, the EIS will also include protocol that the BLM should follow to evaluate new chemicals that may be developed in the future, prior to their use by the agency. These herbicides could only be used if they are: (1) registered for use by the EPA; (2) used for treatment of appropriate vegetation types and at application rates specified on the label directions; and (3) determined to be safe to humans and the environment based on a toxicological and environmental impacts analysis of the herbicides by the BLM.

Public Involvement

Q. When will the public be able to make comments on the project?
A. NEPA regulations require federal agencies to seek public input during development of the EIS. The public will have several opportunities to discuss this project with the BLM and to make comments, such as:

- At public scoping meetings held in 19 cities from January 8 through March 12, 2002.
- By submitting comments on issues identified in the scoping process and any additional issues that should be addressed, through March 29, 2002.
- By submitting comments through additional public comment periods associated with the Draft EIS and Final EIS.

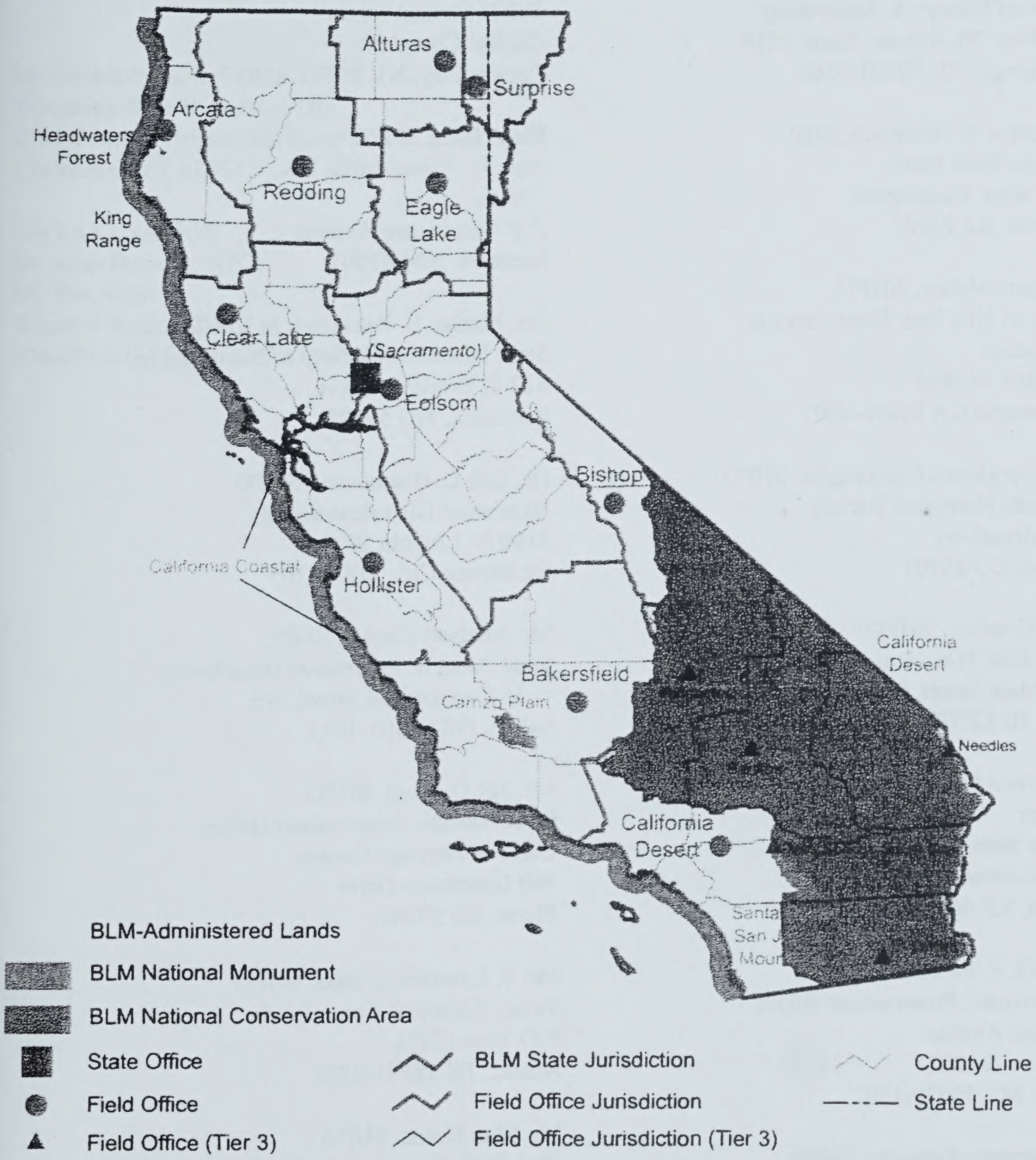
Q. How can the public comment on the program?
A. The public can provide formal comments to the court reporter who will be available during each scoping meeting. Forms to submit written comment will also be available during the scoping meeting, and at local BLM offices, and can be turned in to the BLM at the scoping meeting or local office. These forms, or other written comments, can also be mailed to: Brian Amme, Project Manager, Bureau of Land Management, P.O. Box 12000, Reno, NV 89520-0006. Comments can also be faxed to Mr. Amme at (775) 861-6712.

Q. What will be done with these comments?
A. The comments will be compiled and summarized by major resource areas and issues in a scoping summary report. Public comments, and the scoping summary report, will be used to evaluate issues and concerns associated with the proposed program, and to develop alternative programs to treat vegetation on BLM-administered lands. Alternative programs could involve vegetation treatment using fewer treatment methods than are currently proposed by the BLM, or different amounts of acres treated using each method. The scoping summary report will be made available to the public in late spring.

Q. How can I find out more about the project, review the earlier EISs, and follow the progress of the EIS?
A. A website is currently under construction on the BLM website (www.blm.gov) and will be available in February 2002.

National Science & Technology Center
Bureau of Land Management

California



In addition to the surface acreage shown, the BLM manages 47.5 million acres of subsurface mineral estate for this state jurisdiction.

For more information on this data, contact Keith Francis at NSTC, keith_francis@blm.gov or 303-236-0113.

Ms. Judith Bittner, SHPO
Alaska Department of Natural Resources
Office of History & Archeology
550 West 7th Avenue, Suite 1310
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OMAHA TRIBE OF NEBRASKA

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Valentine Parker, Jr., Vice-Chairman
Doran Morris, Sr., Treasurer
Eleanor Baxter, Secretary

NATURAL RESOURCES

(402) 837-5391
FAX (402) 837-5308

MEMBERS
Clifford R. Wolfe, Jr.
Orville Cayou
Gregory L. Spears

August 13, 2002

Brian Amme
Project Manager
Bureau of Land Management
P.O. BOX 12000
Reno, NV 89520-0006

Re: Bureau of Land Management (BLM) Vegetation Treatments Programmatic Environmental Impact Statement (EIS) for the Western U.S., Including Alaska

Dear Mr. Amme:

We have received the information report prepared for the above-referenced project that BLM is proposing. The purpose of these treatments is to conserve and restore the function of vegetation, watershed, and fish and wildlife habitat and including control of noxious weeds, and the restoration of damaged lands by seeding and replanting.

Thank you for providing the Omaha Tribe with the opportunity to review this undertaking.

We make comment based on the enclosed material, we would like to participate in the environmental process by receiving copies of the documents that BLM produces.

Please keep us informed as to the progress of the project or any additional information.

Feel free to contact this office (402) 837-5391 if you have any questions.

Sincerely,

Kenneth Lyons

Kenneth Lyons
Real Estate Services
Omaha Tribe of Nebraska

Scotts Valley Band of Pomo Indians

July 22, 2002

02 JUL 24 AM 7:30

Brian Amme
Project Manager Vegetation/Habitat Treatments
Bureau of Land Management
P.O. Box 12000
Reno, NV. 89520-0006

Dear Mr. Amme,

I am writing this letter in response to the letter of July 3rd, 2002 requesting input from Tribal agencies about the Vegetation Treatment EIS. Pomo Tribes are world-renowned for the quality of their historic basketweaving. Scotts Valley Band of Pomo Indians is in the process of restoring this tradition among Tribal members, including children. Because Traditional materials such as willow, sedge, and redbud are held in the mouth while splitting, our weavers are **very** concerned about chemical residues that may remain on plants as a result of spraying for vegetation control. The California Indian Basketweaver's Association has completed a study about the persistence of chemicals in the landscape (notably Round-up) that indicates long-term presence (up to 300+ days) in the landscape. This problem is especially important when large tracts of land are subjected to aerial spraying for vegetation control.

Traditional Pomo weavers managed their gathering sites with controlled burns, and therefore, Scotts Valley supports the use of fire as a management tool. We understand that this is controversial due to recent events, but with **closer attention to conditions in the field,** we feel fire can be an excellent management tool. Again, due to chemical residues left by kerosene products, we suggest using propane to start controlled burns in areas where basketweavers are likely to collect materials. The California Indian Basketweaver's Association has made this suggestion to the Parks Service and they are currently using the less detrimental product.

We appreciate your request for comments on this project, and hope that you will take our concerns seriously.

Sincerely,

Diana L. Hershey

Diana Hershey
Planning/Development Manager

9700 Soda Bay Rd. - Kelseyville, California 95451
(707) 277-8870 FAX # 1-707-277-8874

TOHONO O'ODHAM NATION
CULTURAL AFFAIRS DEPARTMENT
P.O. BOX 837 • SELLS, AZ 85634
Telephone (520) 383-3622 • Fax (520) 383-337

August 1, 2002

Brian Amme, Project Manager
Bureau of Land Management
P.O. Box 1200
Reno, Nevada 89520-0006

Dear Mr. Amme:

Thank you for the opportunity to review and comment on the proposed Bureau of Land Management Vegetation Treatments Programmatic Environmental Impact Statement (EIS) for the Western United States, including Alaska.

The Cultural Affairs Office has several comments and questions:

1. Concerns over types of herbicides, please send information on the five new herbicides you are considering for use. Effects on other plants, animals and people.
2. Areas that will be treated with mechanical or manual method that disturb the ground will require completion of archaeological surveys.
3. Once specific areas are identified, State BLM Office need to consult with the tribes in each state.
4. Effects on cultural resource properties need to be evaluated.
5. Effects on plants used by Native Americans for medicines or for crafts.
6. Please send copies of all relevant technical reports.
7. Tribes should be invited to be signatories of any programmatic agreements.
8. Please send copy of Draft EIS
9. Please send list of times and places for scooping meetings Please schedule scooping meetings for the Tohono O'odham Nation.
10. Effects of project on endangered species.

Sincerely,

Peter L Steere

Peter L. Steere
Manager, Cultural Affairs

TUOLUMNE ME-WUK TRIBAL COUNCIL

Post Office Box 699
TUOLUMNE, CALIFORNIA 95379

Telephone (209) 928-3475
Fax (209) 928-1677

United States Department of the Interior
Bureau of Land Management
Washington, DC 20240

To Whom It May Concern:

Subject: EIS for the Western U.S.

In regard to the correspondence received concerning the Programmatic Environmental Impact Statement for the Vegetation Treatments on BLM's Land; the Tribe would like to be kept up on any issues and would like to see a copy of the draft and final EIS statement.

We, as Native Americans are very concerned about the chemical uses on cultural plants, especially basket materials. We hope that the evaluating of the five new herbicides for possible use on public lands will include the long-range effects on cultural plants as well as the effects on our sacred water sources.

We are also concerned due to the fact that a lot of Pre-historical sites do not flag in cultural plants, which we feel are a large part of the cultural significance of any site. These unprotected cultural plants, outside the flag lines are then exposed to the herbicides used on our forestlands.

Thank you for giving us the opportunity to comment upon this large undertaking. We are looking forward to receiving the draft Environmental Statement so that we may also comment on that. If you have any questions you may contact Vicki Biggs, Natural Resource Technician for the Tribe, (209) 928-3475.

Vicki Biggs

Vicki Biggs
Natural Resource Technician
Tuolumne Me-Wuk Tribal Council

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IN REPLY REFER TO

JUL 2 3 2002

Ms. Gina Ramos, Co-team Lead
Renewable Resources and Planning
Bureau of Land Management
Washington, D.C. 200240

Dear Ms. Ramos:

This is to comment on the **Bureau of Land Management (BLM) Vegetation Treatments Programmatic Environmental Impact Statement (EIS) for the Western U.S., Including Alaska** as requested in your letter dated July 3, 2002.

Regarding the BLM's proposed use of herbicides, many American Indian individuals and groups in the Pacific Region actively gather edible plants and basket-making materials from Trust lands and public lands. Edible plants are ingested of course and basket materials are usually placed in the mouth when processing, softening, or when manipulating them during the manufacturing process. These traditional practices need to be considered by the BLM when planning any herbicide treatments. Some tribes have ordinances that prohibit the use of herbicides on their lands to protect their traditional gatherers and/or plants or animals. Because the exact locations of traditional use areas are often confidential or unrecorded, it is recommended that the BLM consult with local tribes on a project by project basis when considering herbicide treatments. It is also recommended you contact the California Basket-makers Association. To obtain contact information for Federally-recognized American Indian and Alaska Native groups, please contact Ms. Daisy West at (202) 208-2475.

Thank you for the opportunity to provide comments. If you have any questions, please contact Jay Hinshaw, Forestry Branch Environmental Compliance Coordinator, at (916) 978-6021, or Ron Recker, Acting Regional Forester, at (916) 978-6065.

Sincerely,

Amy L. Dutschke

Acting Regional Director

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Tribal Leaders and
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Tribal Leaders and
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Pacific Region

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Tribal Leaders and
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STATE HISTORIC PRESERVATION OFFICE CONSULTATION

KSR&C No. 02-07-141

KANSAS

STATE

HISTORICAL

SOCIETY

◆

Cultural Resources Division

◆

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◆

KANSAS HISTORY CENTER

Administration
enter for Historical Research
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HISTORIC SITES

Adair Cabin
Constitution Hall
Cottonwood Ranch
First Territorial Capitol
Fort Hays
Goodnow House
Grinter Place
Hollenberg Station
Kaw Mission
larais des Cygnes Massacre
Mine Creek Battlefield
Native American Heritage Museum
Pawnee Indian Village
Pawnee Rock
Shawnee Indian Mission

August 5, 2002

Gina Ramos
Vegetation EIS Co-Team Lead
US Department of the Interior
Bureau of Land Management
Washington, DC 20240

RE: Vegetation Treatments Programmatic EIS for Western US and Alaska
KS Statewide Projects File

Dear Ms. Ramos:

The Kansas State Historic Preservation Office (SHPO) would like to thank you for requesting our comments regarding the *Proposed Bureau of Land Management (BLM) Vegetation Treatments Programmatic Environmental Impact Statement (EIS) for the Western U.S., Including Alaska.* Because we are unaware of any Bureau of Land Management-administered lands present in the state of Kansas we do not have any concerns for implementation of the proposed vegetation treatments. The SHPO does not have any information to provide the BLM regarding resource areas, subsistence plants or animals, or traditional cultural properties within the state of Kansas of concern to Native American groups. We have chosen not to participate in the environmental process for preparation of the Vegetation EIS and do not wish to receive copies of the documents you produce.

Thank you for allowing us this opportunity to comment. If you have questions or need additional information regarding these comments, please contact Will Banks 785-272-8681 (ex. 214) or Jennifer Epperson (ex. 225).

Sincerely,

Mary R. Allman
State Historic Preservation Officer

Richard Pankratz

Richard Pankratz, Director
Historic Preservation Office

RDP/jee

WYOMING

DEPARTMENT OF STATE PARKS & CULTURAL RESOURCES
STATE HISTORIC PRESERVATION OFFICE

Barrett Building
2301 Central Ave.
Cheyenne, WY 82002

(307) 777-7697
FAX (307) 777-6421

July 31, 2002

Mr. Brian Amme, Project Manager
U.S.D.I. Bureau of Land Management
Washington, D.C. 20240

RE: Bureau of Land Management (BLM) Vegetation Treatments Programmatic Environmental Impact Statement (EIS) for the Western U.S., Including Alaska; SHPO #0702RLC001

Dear: Mr. Amme,

Our staff has received information concerning the aforementioned project. Thank you for allowing us the opportunity to comment.

I am pleased that the BLM is seeking input from Native Americans concerning the effects these proposed treatments may have on resources important to them. Possessing this information prior to the development of the EIS will greatly increase the utility of this document.

There is another issue that I request the BLM analyze as part of the development of this EIS. This is an analysis of the effects of chemical vegetative treatments on organic archaeological remains (these organic remains include, but are not limited to; Carbon 14 dating samples, pollens, seeds, plant fibers, proteins, etc.). This is an issue of considerable concern, particularly the effect of "spike" and other ground penetrating chemical treatments. Addressing this issue as part of this EIS would greatly reduce concems and confusion during the future development of project specific NEPA documents.

Please refer to SHPO project control number #0702RLC001 on any future correspondence dealing with this project. If you have any questions, contact me at 307-777-5497.

Sincerely,

Richard L. Currit

Richard L. Currit
State Historic Preservation Officer

RLC:jh

ENVIRONMENTAL PROTECTION AGENCY CONSULTATION

August 28, 2003

In Reply Refer To:
4000 (220)

MR 8/25/03

Dr. Tom Bailey, Chief
Environmental Protection Agency
Office of Prevention, Pesticides, and Toxic Substances
Environmental Risk Branch II
Environmental Fate and Effects Division (7505C)
Ariel Rios Building
1200 Pennsylvania Avenue, NW.
Washington, D.C. 20460

Dear Dr. Bailey:

Thank you for your Agency's comments addressing the Bureau of Land Management's (BLM) "A General Approach to the Ecological Risk Assessment (ERA) for the BLM Vegetation Treatment Environmental Impact Statement."

In May of 2002 two Toxicology Risk Assessment Teams were assembled to address both human health and ecological risks for herbicide use and practices on public lands. The teams included representatives from BLM, BLM's EIS contractor ENSR, Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), and the Environmental Protection Agency (EPA). The risk assessment teams had two purposes. The first was to review current and past methodologies used for risk assessments by the BLM and other agencies, including the EPA. The other purpose was to develop a consensus on which methodologies provided the best available science and process or protocol the BLM would use to conduct future human health and ecological risk analyses for chemical herbicides proposed for use on public lands administered by the BLM.

The comments and input provided by the EPA have been invaluable in this effort. The enclosed comment sheet and final ERA document outlines where the BLM has reviewed and incorporated your agency comments. We would like to especially thank Mike Davy from your Environmental Fate and Effects Division for his assistance in helping the BLM to develop the protocol.

If you have any questions or comments, please contact Gina Ramos, National Vegetation EIS Co-Team lead, at 202-452-5084.

Sincerely,

/s/James G. Kenna (Acting)

Assistant Director, Renewable Resources
and Planning

Enclosure

LLM:220 1620 LS Rm. 204:Gramos:pat:8/12/03:452-5084:EPALetter

August 28, 2003

In Reply Refer To:
4000 (220)

Memorandum

To: Gary Frazier
Assistant Director for Endangered Species, FWS

From: Assistant Director, Renewable Resources and Planning
Bureau of Land Management

Subject: A General Approach to the Ecological Risk Assessment (ERA) for the Bureau of Land Management (BLM) Vegetation Treatment Environmental Impact Statement (EIS)

In May 2002, two Toxicology Risk Assessment Teams were assembled to address both human health and ecological risks for herbicide use and practices on public lands. The teams included representatives from the BLM, BLM's EIS contractor ENSR, Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), and the Environmental Protection Agency (EPA). The risk assessment teams had two purposes. The first was to review current and past methodologies used for risk assessments by the BLM and other agencies, including the EPA. The other purpose was to develop a consensus on which methodologies provided the best available science and process or protocol the BLM would use to conduct future human health and ecological risk analyses for chemical herbicides proposed for use on public lands administered by the BLM.

The BLM has finalized the attached ERA and will immediately start the risk assessments. The BLM will include the information from the risk assessments in the Draft EIS's Analysis section as well as in the Biological Assessment. We look forward to working with the FWS on the next phase of the EIS as well as ESA consultation. If you have any questions or comments, please contact Gina Ramos, Co-team lead at 202-452-5084.

/s/James G. Kenna (Acting)

Attachment

LLM:220 1620 LS Rm. 204:Gramos:pat:452-5084:FWSLetter

Gkamos
8-20-03

August 28, 2003

In Reply Refer To:
4000 (220)

Ms. Laurie K. Allen
Acting Director, NOAA
National Marine Fisheries Service
Office of Protected Resources, F/PR-3
1315 East-West Highway
Silver Spring, Maryland 20910

Dear Ms. Allen:

Thank you for your comments addressing the Bureau of Land Management's (BLM) "A General Approach to the Ecological Risk Assessment (ERA) for the BLM Vegetation Treatment Environmental Impact Statement (EIS)."

In May 2002 two Toxicology Risk Assessment Teams were assembled to address both human health and ecological risks for herbicide use and practices on public lands. The teams included representatives from the BLM, BLM's EIS contractor ENSR, Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), and the Environmental Protection Agency (EPA). The risk assessment teams had two purposes. The first was to review current and past methodologies used for risk assessments by the BLM and other agencies, including the EPA. The other purpose was to develop a consensus on which methodologies provided the best available science and process or protocol the BLM would use to conduct future human health and ecological risk analyses for chemical herbicides proposed for use on public lands administered by the BLM.

The comments and input provided by NOAA have been very helpful. The enclosed comment sheet and final ERA document outlines where the BLM has reviewed and incorporated your agency comments. We would like to especially thank Kellie Foster and Rachel Friedman for their participation and assistance in helping the BLM to develop the protocol. If you have any questions or comments, please contact Gina Ramos, Co-team lead, at 202-452-5084.

Sincerely,

/s/James G. Kenna (Acting)

Assistant Director, Renewable Resources
and Planning

Enclosure
LLM:220 1620 LS Rm. 204:Gramos:pat:8/12/03:452-5084:NOAAFisheriesdoc.

U.S. FISH AND WILDLIFE SERVICE AND NOAA NATIONAL MARINE FISHERIES SERVICE CONSULTATION

Ysr
6-7-02

June 12, 2002

In Reply Refer To:
9015 (220)

OG Bnl f 6/7
ecdaly 6/12/02

Mr. Don Knowles
Director, National Marine Fisheries Service
Office of Protected Resources, F/PR3
1315 East-West Highway
Silver Spring, Maryland 20910

Dear Mr. Knowles:

On November 13, 2001, the Bureau of Land Management (BLM) met with Kellie Carter and Craig Johnson of the National Marine Fisheries Service (NMFS) and Rick Sayers and Jim Serfis of the U.S. Fish and Wildlife Service (FWS). The purpose of the meeting was to discuss the procedure for preparing a consultation agreement for the BLM's National Programmatic Environmental Impact Statement (EIS) for Vegetation Treatments. At this meeting, all three agencies agreed that the consultation would proceed according to the Section 7 Interagency Cooperation regulations at 50 CFR Part 402.

The BLM intends the national EIS to be a framework for the treatments of vegetation on BLM managed lands. Because the national EIS is broad in scope, specific details of every potential application will not be included in the EIS. Consequently, local and/or State BLM offices will still be required to conduct site specific consultations with the FWS and NMFS on actions determined to "May Affect" a listed species or adversely modify designated critical habitats.

Identification of Agency Points of Contact for the preparation of the Vegetation EIS and consultation:

Jim Serfis (FWS) and Kellie Carter (NMFS) will serve as the Points of Contacts (POC's) for their respective agencies on the Vegetation EIS. Both will also serve as team members on the EIS Interdisciplinary Team. As team members, they will provide agency input into the EIS and coordinate preparation of the Biological Opinions (BO's).

The POC's will represent their agency interests and act as the liaison to their agency staff. The BLM and ENSR International (BLM contractor) will coordinate with the POC's to develop the EIS schedule, to gather information and to contact their respective field offices for information,

and to review documents. We agreed that the POC's would attend the Vegetation EIS Interdisciplinary Team meetings and public scoping meetings whenever possible. The POC's or their representatives will also participate in conference calls and plan reviews to provide expertise regarding threatened and endangered species matters during the development of the ecological risk assessment work plan.

Initiating Consultation:

Discussions with the FWS and NMFS began on November 13, 2001. Public scoping meetings began in January 2002 and completed on March 12, 2002. After the draft public scoping report has been prepared and reviewed, the BLM, FWS, and NMFS will begin discussions to identify the "Action Area," identify potential effects to listed and proposed species and their critical habitat from the vegetation treatment methods, i.e., prescribed burning, chemical, mechanical, biological controls that will take place on BLM-managed surface lands (on a programmatic basis), identify the information needed to initiate the formal consultation process, and decide how to deal with the proposed treatment methods. These discussions will begin as soon as possible. The BLM will also develop the Preferred Alternative during this time.

The BLM will prepare an initiation package for the FWS and NMFS to begin the formal consultation process. Before preparation of the initiation package, BLM will work closely with NMFS and FWS to make the package as detailed and comprehensive as possible. Formal consultation will be initiated when the package provides all relevant data required by 50 CFR §402.14 (c) and when NMFS and FWS have received the required information. The initiation package will include the draft Biological Assessment (BA).

As part of the initiation package, the BLM will identify the effects of the proposed action on threatened, endangered, and proposed species and their critical habitat. For information on the effects of current and proposed herbicides (see attached lists of current and proposed herbicides) on threatened and endangered species, the BLM will provide FWS and NMFS information on these herbicides to the extent that the information is available to the public from the Environmental Protection Agency (EPA) and other sources, including industry. Such information may include toxic risks to listed species and fate, transport and monitoring methods to assess effectiveness of best management practices (BMP's).

When information is not available for currently approved or proposed herbicides, the BLM along with NMFS and FWS will make an assessment based on the relevant information. This information may be from studies of similar herbicides as to the likely effects to threatened and endangered species. For this EIS, the BLM will only be including those herbicides that have already received EPA labeling for range, forestry, rights of ways, and aquatic use. For those herbicides currently in use and addressed in the previous EIS's, no additional risk assessments will be prepared. Project specific consultation will rely on programmatic level risk assessments and will not require that additional, local risk assessments be prepared.

As discussed in the initial meeting, if the BLM determines that an action "May Affect" a listed species or its designated critical habitat and NMFS/FWS concur, the BLM may be able to modify the action to eliminate any adverse effects. If the BLM determines that an action is "likely to Adversely Affect" (LAA) a listed species or designated critical habitat, the BLM will attempt to modify the action to avoid such adverse effects.

To better assess the threats to listed and proposed species and their critical habitat, the BLM, FWS, and NMFS will begin discussions on the effects of the proposed action before the formal consultation stage to ensure that this information will be included in the Biological Opinion.

Initiation of formal consultation with the FWS and NMFS will occur with the release of the draft EIS. At that time, BLM will submit a final BA to the FWS and NMFS. Separate draft Biological Opinions will be completed by FWS and NMFS 135 days after formal consultation has begun, unless FWS, NMFS, and BLM mutually agree upon an extension. The BLM will review the draft Biological Opinions before the FWS and NMFS submit the final Biological Opinions. We anticipate that the final Biological Opinions will be submitted to BLM just before release of the Final EIS so that the BLM can publish the documents concurrently. The anticipated date for publication of the Biological Opinions and Final EIS is in the Summer of 2003. Both NMFS and FWS will assist BLM in reviewing the comments that BLM receives on the Draft EIS and will help BLM to develop the information to support the Final EIS. The BLM understands that if the selected alternative is not the preferred alternative, BLM will reinitiate consultation.

Information that BLM and ENSR will provide for NMFS and FWS:

The BLM intends the EIS to be a framework for the treatments of vegetation, but BLM will still require local and/or State offices to conduct site-specific consultations with the FWS and NMFS. As part of the BLM's commitment to protect listed and proposed species, the BLM will ensure that actions are not likely to jeopardize the continued existence of any listed or proposed species or result in the destruction or adverse modification of designated or proposed critical habitat. The BLM, along with assistance from NMFS and FWS, will modify the vegetation treatments in the preferred alternative to avoid the likelihood of jeopardy and adverse modification of critical habitat. Evaluation of the effects of the vegetation treatments will be to determine the "short-term harm versus the long-term good."

The Programmatic Biological Assessment will provide an overall framework for species assessments. A detailed Biological Assessment will need to be prepared for individual projects at the field office level (site-specific level analysis). The BLM will prepare an assessment for each listed species likely to be impacted by the proposed action or likely to be found in areas where vegetation treatments will occur. The BLM will provide sufficient information for each species needed to determine the effects of vegetation treatments on the species and their habitat.

Where practical, the BLM may group species based on habitat requirement or taxonomy when conducting analyses of the effect. Watersheds will identify the "action area" for some species and may be taken down to the 4th Hydrologic Unit Classification (HUC) Level.

The EIS will address threatened, endangered, and proposed species and designated and proposed critical habitat. The Biological Assessment will not address candidate species although some of these species, will be assessed in the EIS. The BLM will review State lists of threatened and endangered and sensitive species. The BLM will confer with individual States that have their own Threatened and Endangered Species Law (Oregon and California) if they require additional consultation.

Information that the BLM will gather before consultation begins and separate requirements from each agency:

The BLM understands that NMFS and FWS use the same guidance under the Endangered Species Act (ESA) for species and critical habitats. As required by NMFS, the BLM will prepare an Essential Fish Habitat Plan and coordinate the preparation of the documents with the NMFS POC and the NMFS Office of Habitat.

Timelines for EIS ID team meetings, products, reports and updates:

The BLM understands that the FWS and NMFS will provide no intermediate documents. Schedules will be coordinated with BLM and ENSR that meet the EIS schedule. The BLM will review the consultation flowchart with FWS and NMFS for any further clarification. To stay on schedule, the BLM will coordinate with the POCs for NMFS and FWS to ensure that schedules are met and to identify any problems during the informal and formal consultation process.

The BLM, FWS, and NMFS will need to closely coordinate activities throughout the EIS process to ensure that we have the Biological Opinion by the time the Final EIS is completed. Gary Frazer, Assistant Director for Endangered Species, will sign the Biological Opinion for the FWS, and Don Knowles, Director of the Office of Protected Resources, will sign the Biological Opinion for the National Marine Fisheries Service.

If you have any questions or comments concerning the EIS, please contact Gina Ramos at 202-452-5084, Brian Amme, Vegetation EIS co-team leads at 202-452-5084 or 775-862-6645, or Tim Reuwsaat, Group Manager for Resources at 202-452-5179.

Sincerely,
/s/Elena C. Daly

Assistant Director, Renewable Resources
and Planning

Enclosure

LLM:220 1620 LS Rm. 201:GRamos:452-5084:pat:6/7/02:NMFS&FWSconsultation

Currently Approved Herbicides from BLM Environmental Impact Statements

Northwest Area Noxious Weed Control Program, December 1985

2,4-D
Picloram
Dicamaba
Glyphosate (Rodeo formulation)

California Vegetation Management FEIS, August 1988

Amitrole
Asulam
Atrazine
Bromacil
2,4-D
Dalapon
Dicamba
Diuron
Fosamine
Glyphosate
Hexazinone
Picloram
Simazine
Tebuthiuron
Triclopyr

Vegetation Treatment EIS - Thirteen Western States, July 1991

Atrazine
Bromacil
Chlorsulfuron
Clopyralid
2,4-D
Dicamba
Diuron
Glyphosate
Hexazinone
Imazapyr
Mefluidide
Metsulfuron Methyl
Picloram
Simazine

Sulfometuron Methyl
Tebuthiuron
Triclopyr

Western Oregon FEIS, August 1992

Asulam
Atrazine
2,4-D
Dicamba
Glyphosate
Hexazinone
Picloram
Triclopyr

New Proposed Herbicides to be analyzed in the Vegetation EIS

Diquat
Fluridone
Imazapic
Diflufenzopyr
MCPA

June 12, 2002

In Reply Refer To:
9015 (220)

Mr. Don Knowles
Director, National Marine Fisheries Service
Office of Protected Resources, F/PR3
1315 East-West Highway
Silver Spring, Maryland 20910

Dear Mr. Knowles:

On November 13, 2001, the Bureau of Land Management (BLM) met with Kellie Carter and Craig Johnson of the National Marine Fisheries Service (NMFS) and Rick Sayers and Jim Serfis of the U.S. Fish and Wildlife Service (FWS). The purpose of the meeting was to discuss the procedure for preparing a consultation agreement for the BLM's National Programmatic Environmental Impact Statement (EIS) for Vegetation Treatments. At this meeting, all three agencies agreed that the consultation would proceed according to the Section 7 Interagency Cooperation regulations at 50 CFR Part 402.

The BLM intends the national EIS to be a framework for the treatments of vegetation on BLM managed lands. Because the national EIS is broad in scope, specific details of every potential application will not be included in the EIS. Consequently, local and/or State BLM offices will still be required to conduct site specific consultations with the FWS and NMFS on actions determined to "May Affect" a listed species or adversely modify designated critical habitats.

Identification of Agency Points of Contact for the preparation of the Vegetation EIS and consultation:

Jim Serfis (FWS) and Kellie Carter (NMFS) will serve as the Points of Contacts (POC's) for their respective agencies on the Vegetation EIS. Both will also serve as team members on the EIS Interdisciplinary Team. As team members, they will provide agency input into the EIS and coordinate preparation of the Biological Opinions (BO's).

The POC's will represent their agency interests and act as the liaison to their agency staff. The BLM and ENSR International (BLM contractor) will coordinate with the POC's to develop the EIS schedule, to gather information and to contact their respective field offices for information,

and to review documents. We agreed that the POC's would attend the Vegetation EIS Interdisciplinary Team meetings and public scoping meetings whenever possible. The POC's or their representatives will also participate in conference calls and plan reviews to provide expertise regarding threatened and endangered species matters during the development of the ecological risk assessment work plan.

Initiating Consultation:

Discussions with the FWS and NMFS began on November 13, 2001. Public scoping meetings began in January 2002 and completed on March 12, 2002. After the draft public scoping report has been prepared and reviewed, the BLM, FWS, and NMFS will begin discussions to identify the "Action Area," identify potential effects to listed and proposed species and their critical habitat from the vegetation treatment methods, i.e., prescribed burning, chemical, mechanical, biological controls that will take place on BLM-managed surface lands (on a programmatic basis), identify the information needed to initiate the formal consultation process, and decide how to deal with the proposed treatment methods. These discussions will begin as soon as possible. The BLM will also develop the Preferred Alternative during this time.

The BLM will prepare an initiation package for the FWS and NMFS to begin the formal consultation process. Before preparation of the initiation package, BLM will work closely with NMFS and FWS to make the package as detailed and comprehensive as possible. Formal consultation will be initiated when the package provides all relevant data required by 50 CFR §402.14 (c) and when NMFS and FWS have received the required information. The initiation package will include the draft Biological Assessment (BA).

As part of the initiation package, the BLM will identify the effects of the proposed action on threatened, endangered, and proposed species and their critical habitat. For information on the effects of current and proposed herbicides (see attached lists of current and proposed herbicides) on threatened and endangered species, the BLM will provide FWS and NMFS information on these herbicides to the extent that the information is available to the public from the Environmental Protection Agency (EPA) and other sources, including industry. Such information may include toxic risks to listed species and fate, transport and monitoring methods to assess effectiveness of best management practices (BMP's).

When information is not available for currently approved or proposed herbicides, the BLM along with NMFS and FWS will make an assessment based on the relevant information. This information may be from studies of similar herbicides as to the likely effects to threatened and endangered species. For this EIS, the BLM will only be including those herbicides that have already received EPA labeling for range, forestry, rights of ways, and aquatic use. For those herbicides currently in use and addressed in the previous EIS's, no additional risk assessments will be prepared. Project specific consultation will rely on programmatic level risk assessments and will not require that additional, local risk assessments be prepared.

As discussed in the initial meeting, if the BLM determines that an action "May Affect" a listed species or its designated critical habitat and NMFS/FWS concur, the BLM may be able to modify the action to eliminate any adverse effects. If the BLM determines that an action is "likely to Adversely Affect" (LAA) a listed species or designated critical habitat, the BLM will attempt to modify the action to avoid such adverse effects.

To better assess the threats to listed and proposed species and their critical habitat, the BLM, FWS, and NMFS will begin discussions on the effects of the proposed action before the formal consultation stage to ensure that this information will be included in the Biological Opinion.

Initiation of formal consultation with the FWS and NMFS will occur with the release of the draft EIS. At that time, BLM will submit a final BA to the FWS and NMFS. Separate draft Biological Opinions will be completed by FWS and NMFS 135 days after formal consultation has begun, unless FWS, NMFS, and BLM mutually agree upon an extension. The BLM will review the draft Biological Opinions before the FWS and NMFS submit the final Biological Opinions. We anticipate that the final Biological Opinions will be submitted to BLM just before release of the Final EIS so that the BLM can publish the documents concurrently. The anticipated date for publication of the Biological Opinions and Final EIS is in the Summer of 2003. Both NMFS and FWS will assist BLM in reviewing the comments that BLM receives on the Draft EIS and will help BLM to develop the information to support the Final EIS. The BLM understands that if the selected alternative is not the preferred alternative, BLM will reinitiate consultation.

Information that BLM and ENSR will provide for NMFS and FWS:

The BLM intends the EIS to be a framework for the treatments of vegetation, but BLM will still require local and/or State offices to conduct site-specific consultations with the FWS and NMFS. As part of the BLM's commitment to protect listed and proposed species, the BLM will ensure that actions are not likely to jeopardize the continued existence of any listed or proposed species or result in the destruction or adverse modification of designated or proposed critical habitat. The BLM, along with assistance from NMFS and FWS, will modify the vegetation treatments in the preferred alternative to avoid the likelihood of jeopardy and adverse modification of critical habitat. Evaluation of the effects of the vegetation treatments will be to determine the "short-term harm versus the long-term good."

The Programmatic Biological Assessment will provide an overall framework for species assessments. A detailed Biological Assessment will need to be prepared for individual projects at the field office level (site-specific level analysis). The BLM will prepare an assessment for each listed species likely to be impacted by the proposed action or likely to be found in areas where vegetation treatments will occur. The BLM will provide sufficient information for each species needed to determine the effects of vegetation treatments on the species and their habitat.

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The BLM understands that NMFS and FWS use the same guidance under the Endangered Species Act (ESA) for species and critical habitats. As required by NMFS, the BLM will prepare an Essential Fish Habitat Plan and coordinate the preparation of the documents with the NMFS POC and the NMFS Office of Habitat.

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The BLM, FWS, and NMFS will need to closely coordinate activities throughout the EIS process to ensure that we have the Biological Opinion by the time the Final EIS is completed. Gary Frazer, Assistant Director for Endangered Species, will sign the Biological Opinion for the FWS, and Don Knowles, Director of the Office of Protected Resources, will sign the Biological Opinion for the National Marine Fisheries Service.

If you have any questions or comments concerning the EIS, please contact Gina Ramos at 202-452-5084, Brian Amme, Vegetation EIS co-team leads at 202-452-5084 or 775-862-6645, or Tim Reuwsaat, Group Manager for Resources at 202-452-5179.

Sincerely,
/s/Elena C. Daly

Assistant Director, Renewable Resources
and Planning

Enclosure

LLM:220 1620 LS Rm. 201:GRamos:452-5084:pat:6/7/02:NMFS&FWSconsultation

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Picloram
Triclopyr

New Proposed Herbicides to be analyzed in the Vegetation EIS

Diquat
Fluridone
Imazapic
Diflufenzopyr
MCPA

August 28, 2003

In Reply Refer To:
4000 (220)

Kolania
8-25-03

Memorandum

To: Gary Frazier
Assistant Director for Endangered Species, FWS

From: Assistant Director, Renewable Resources and Planning
Bureau of Land Management

Subject: A General Approach to the Ecological Risk Assessment (ERA) for the Bureau of Land Management (BLM) Vegetation Treatment Environmental Impact Statement (EIS)

In May 2002, two Toxicology Risk Assessment Teams were assembled to address both human health and ecological risks for herbicide use and practices on public lands. The teams included representatives from the BLM, BLM's EIS contractor ENSR, Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), and the Environmental Protection Agency (EPA). The risk assessment teams had two purposes. The first was to review current and past methodologies used for risk assessments by the BLM and other agencies, including the EPA. The other purpose was to develop a consensus on which methodologies provided the best available science and process or protocol the BLM would use to conduct future human health and ecological risk analyses for chemical herbicides proposed for use on public lands administered by the BLM.

The BLM has finalized the attached ERA and will immediately start the risk assessments. The BLM will include the information from the risk assessments in the Draft EIS's Analysis section as well as in the Biological Assessment. We look forward to working with the FWS on the next phase of the EIS as well as ESA consultation. If you have any questions or comments, please contact Gina Ramos, Co-team lead at 202-452-5084.

/s/James G. Kenna (Acting)

Attachment

LLM:220 1620 LS Rm. 204:Gramos:pat:452-5084:FWSLetter

Gkamos 8-20

August 28, 2003

In Reply Refer To:
4000 (220)

Ms. Laurie K. Allen
Acting Director, NOAA
National Marine Fisheries Service
Office of Protected Resources, F/PR-3
1315 East-West Highway
Silver Spring, Maryland 20910

Dear Ms. Allen:

Thank you for your comments addressing the Bureau of Land Management's (BLM) "A General Approach to the Ecological Risk Assessment (ERA) for the BLM Vegetation Treatment Environmental Impact Statement (EIS)."

In May 2002 two Toxicology Risk Assessment Teams were assembled to address both human health and ecological risks for herbicide use and practices on public lands. The teams included representatives from the BLM, BLM's EIS contractor ENSR, Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), and the Environmental Protection Agency (EPA). The risk assessment teams had two purposes. The first was to review current and past methodologies used for risk assessments by the BLM and other agencies, including the EPA. The other purpose was to develop a consensus on which methodologies provided the best available science and process or protocol the BLM would use to conduct future human health and ecological risk analyses for chemical herbicides proposed for use on public lands administered by the BLM.

The comments and input provided by NOAA have been very helpful. The enclosed comment sheet and final ERA document outlines where the BLM has reviewed and incorporated your agency comments. We would like to especially thank Kellie Foster and Rachel Friedman for their participation and assistance in helping the BLM to develop the protocol. If you have any questions or comments, please contact Gina Ramos, Co-team lead, at 202-452-5084.

Sincerely,

/s/James G. Kenna (Acting)

Assistant Director, Renewable Resources
and Planning

Enclosure
LLM:220 1620 LS Rm. 204:Gramos:pat:8/12/03:452-5084:NOAAFisheriesdoc.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

In Reply Refer to:
FWS/AES/DHCR/016804

APR 1 2004

Memorandum

To: Assistant Director –Endangered Species

From: Acting Chief, Division of Consultation, Habitat Conservation Planning, Recovery & State Grants

Subject: Consultation Agreement with BLM on the Vegetation Treatment Programmatic Environmental Impact Statement

Attached is a Consultation Agreement that describes the process that the Service and BLM will follow to complete the consultation for BLM's Vegetation Treatment program. BLM requested that we enter into the agreement to ensure an understanding of how the parties would work together and offer a timeline for the process. We worked with BLM to develop the agreement and have reviewed the document that has been finalized by BLM staff.

Please note that there are two copies to be signed and that one of the copies has been already signed by Judge Shepard. BLM staff requested that we retain the document signed by Judge Shepard and forward the document with your signature to BLM. Please let me know if you have any questions regarding the document.

Attachment

BUREAU OF LAND MANAGEMENT

and

U.S. FISH AND WILDLIFE SERVICE,

CONSULTATION AGREEMENT FOR THE

VEGETATION TREATMENTS PROGRAMMATIC

ENVIRONMENTAL IMPACT STATEMENT

A. Purpose and Need:

This Consultation Agreement (Agreement) is formulated to establish an effective and cooperative process upon which the Endangered Species Act (ESA) Section 7 Consultation may be conducted between the Bureau of Land Management (BLM), Rangelands, Soil, Water and Air Group, Washington DC, and the U.S. Fish and Wildlife Service, Region 9 Washington DC Office (Service). This Agreement addresses consultation and conferencing on all species determined to be listed as threatened or endangered, or proposed for listing, and designated or proposed critical habitat occurring on the Federal lands managed by the BLM.

This Agreement will serve to define the process, products, actions, schedule and expectations of the BLM and the Service regarding the consultation process for the *Vegetation Treatments Programmatic Environmental Impact Statement* (Vegetation Treatments EIS).

The Federal agencies will convene an interagency team composed of their employees to conduct this consultation.

B. Consultation Background:

The BLM manages 261 million acres of public land resources. BLM and its contractor, ENSR, are preparing a *Vegetation Treatments Programmatic Environmental Impact Statement* to evaluate proposed vegetation treatment methods and alternatives on lands administered by the BLM in the western continental United States and Alaska. This EIS is to serve to update the following four EISs developed by the BLM in the mid 1980s and early 1990s:

- Northwest Area Noxious Weed Control Program – 1986
- California Vegetation Management – 1988
- Vegetation Treatment of BLM Lands in Thirteen Western States – 1991
- Western Oregon Program Management of Competing Vegetation – 1992

The EIS will provide updated information and analyses provided in the earlier programmatic EISs, where necessary, to ensure that ongoing and proposed vegetation treatment methods are safe to humans and the environment and meet treatment objectives. Information provided in the EIS will help the BLM ensure that BLM vegetation treatment activities comply with applicable federal, state, local, and tribal laws, regulations, statutes, policies, and management plans.

C. Authority:

Authority to enter into this Agreement is contained in the following:

Endangered Species Act of 1973, as amended
Federal Land Policy and Management Act of 1976
Memorandum of Agreement on Endangered Species Act Section 7 Programmatic Consultation and Coordination among BLM, USDA Forest Service, NMFS, and the FWS, August 30, 2000

D. Consultation Action:

This Agreement encourages streamlining of the consultation process in the preparation of the Vegetation Treatments EIS. This increased coordination will enable the Vegetation Treatments EIS to incorporate species habitat needs and will facilitate and expedite the consultation process.

In November 2001, Informal Section 7 Consultation began with the Service on the Vegetation Treatments EIS. Formal consultation will commence when a complete written initiation request, as defined in 50 CFR 402.14 (c), including the draft Vegetation Treatments Programmatic Biological Assessment (BA) for the Draft Vegetation Treatments EIS, is received and determined to be complete by the FWS.

It is anticipated that BLM will initiate formal consultation with the Service at the time the Draft EIS is issued. The BLM will submit a draft BA as part of its consultation package. The Service will review the draft BA and notify the BLM within 30 days of any missing information in the BA. Once the draft BA is considered complete by the Service, a final BA will be prepared. The BLM will then prepare a written initiation request to start formal consultation. The Service will conduct the formal consultation within a 135-day time frame. The level of information expected in the programmatic biological consultation is unlikely to provide sufficient detail to reach conclusions that incidental take is reasonably certain to occur. Therefore, any incidental take exemptions would be deferred to site-specific consultations where sufficient detail would be available. Any request for an extension of the formal consultation period will be made by mutual agreement between BLM and the FWS.

The BA will follow the outline as found in guidance in the Endangered Species Consultation Handbook (March 1998). Anticipated environmental effects, conservation actions, mitigation, and monitoring will be disclosed in the BA. This includes analysis of direct, indirect, and interrelated and interdependent effects on listed, proposed, or candidate species, and/or designated or proposed critical habitat from the analysis of the actions in the Vegetation Treatments EIS.

E. **Operations:**

The BLM agrees to:

1. Appoint Ms.Gina Ramos as the primary contact regarding all BA and ESA issues and as BLM's consultation team member. If Ms. Ramos is not available, the secondary contact person is Mr. Brian Amme. Ms. Carol Spurrier will work with Ms. Ramos and Mr. Amme as necessary to facilitate consultation. If there are any unforeseeable changes in personnel, new contact person names and phone numbers will be immediately provided to the Service.

2. Prepare an assessment for each listed species that may potentially be impacted by the proposed action or likely to be found in areas where vegetation treatments would occur. The BLM will provide sufficient information for each species needed to determine the effects of vegetation treatments on the species and their habitat use. Where practical, the BLM may group species based on habitat requirement or taxonomy when conducting the affects analyses. The Programmatic BA will provide an overall framework for species assessments with a more detailed BA prepared for individual projects (site-specific level analysis).

3. Address candidate species in the BA. The BLM will review state lists of threatened and endangered and sensitive species and will confer with individual states that have their own threatened and endangered species law (Oregon and California) if they require additional consultation.

4. Will prepare an Essential Fish Habitat Plan and coordinate the preparation of the document with the Office of Habitat, NOAA Fisheries.

5. Submit recent risk assessments prepared by the BLM on chemicals that will be applied on BLM lands as part of the Vegetation Treatments EIS consultation package.

6. Submit recent risk assessments written by the FS on chemicals that will be applied on BLM lands as part of the Vegetation EIS consultation package.

7. Provide copies of the old BLM vegetation treatments EISs (as necessary), a copy of the preparation plan, and copies of relevant supporting documents as they are completed.

8. Hold meetings, conference calls, etc., as needed. If a milestone problem occurs, a conference call will be held to discuss the problem.

9. Appoint Mr. Bud Cribley and Mr. Dwight Fielder to the Division Chief/Group Manager Resolution Working Group; Appoint Mr. Ed Shepard to the Assistant Director Resolution Working Group and, Appoint Mr. Jim Hughes to the Director Resolution Working Group.

10. If there are any unforeseeable changes in personnel, new contact person names and phone numbers will be immediately provided to the FWS.

11. Provide a 90-day time frame for review of a final BA.

12. Identify all time commitments (see Attachment A). If the schedule for BLM provision of documents and other information has not been met and changes are required, changes to deadlines will not be finalized without mutual agreement with the Service on the necessary deadline changes.

The FWS agrees to:

1. Appoint Mr. Jim Serfis as the primary contact regarding all BA and ESA issues. If there are any unforeseeable changes in personnel, new contact person names and phone numbers will be immediately provided to the BLM and NOAA Fisheries.

2. Coordinate with counterpart offices for the purposes of this consultation, including identification of additional listed species list to be included in the Vegetation Treatments EIS project area.

3. Participate in milestone meetings, conference calls, etc.

4. Provide threatened and endangered species expertise to help the BLM identify conservation opportunities during preparation of the Vegetation Treatments EIS.

5. Provide a BO within the 135-day timeframe, unless extended by mutual consent.

6. Appoint Mr. Patrick Leonard to the Division Chief/Group Manager Resolution Working Group; Appoint Mr. Gary Frazer to the Assistant Director Resolution Working Group and, Appoint Mr. Clint Riley to the Director Resolution Working Group. If there are any unforeseeable changes in personnel, new contact person names and phone numbers will be immediately provided to the BLM.

7. Meet the time commitment found in Attachment A. Any scheduled changes will be made by mutual agreement.

The BLM and Service mutually agree to:

1. Provide early notification if any problems may arise that would affect the documents or timeframes.

2. Allow the primary contact personnel to make all the necessary changes to the timeframes. The Group Manager and Supervisor will only become involved if the problem becomes elevated and problem items require signatures.

3. Follow the initiation criteria as outlined in 50 402.14(c) in preparation of the initiation package.

4. Consider this as a programmatic level consultation. All Actions that could affect species will undergo consultation at the Field Office level. As part of the BLM's commitment to protect threatened and endangered species, the BLM will ensure that actions are taken to avoid a "jeopardy opinion." This is to ensure that there is continued existence of the listed species or no adverse modification of a designated critical habitat. The BLM, along with the Service, may design mitigation action for vegetation treatments that must be followed to avoid a jeopardy opinion. The focus of the intended outcome of the vegetation treatments will be to evaluate the "short term harm versus the long term good."

5. Describe a process for completing consultations at the state office and field office levels.

6. Review the comments that the BLM receives on the Draft EIS and develop the information to support the Final EIS. The BLM understands it that if the selected alternative is not the preferred alternative, BLM will reinitiate consultation.

7. Agree on effects during the informal consultation stage in order to ensure that this information will be included in the BO.

8. Coordinate as partners by mutually agreeing on conservation measures to promote recovery that will be included in the Vegetation Treatments EIS.

9. Only amend the Agreement by consensus of both parties.

10. Terminate the Agreement only if one party gives 60 day written notice.

11. Acknowledge that this Agreement is only to improve the internal management of this consultation by the BLM and the Service, and is not intended to and does not create any right or benefit, substantive or procedural, enforceable at law or equity by a party against the United states, its agencies or instrumentalities, its officers or employees, or any other person. Nothing in this Agreement shall be construed as obligating either party to the expenditure of funds, or for the future payment of money, in excess of appropriations authorized by law.

12. Recognize the use of Issue Resolution Teams (IRT) if an impasse is reached regarding any aspect of this process, Agreement, or with any of the documents. Elevations of issues to IRTs will follow these tiers: Division Chief/Group Manager Level, Assistant Director Level, and Director Level. After 15 days, the Division Chief/Group Manager level Resolution Working Group will send unresolved issues to the Assistant Director Level Resolution Working Group. If resolution cannot be achieved within 15 days at the Assistant Director Level, the issue will be elevated to the Director Level. The Director Level Issue Resolution

Working group decisions will be issued within 15 days and are the final and binding resolutions of disputes.

13. All issue resolution working group reviews should be initiated by request of the applicable working group, or a specific agency. The request will include (1) a concise summary of issues in dispute and decisions that need to be made (2) agency position statements on each of the issues (3) all supporting rationale and documentation for consideration; and (4) a brief chronology of key actions taken to resolve the dispute.

F. Term

This Agreement shall take effect upon the date of the last signature. It shall remain in effect for four years, or until the BO for the BLM Vegetation EIS is completed, whichever comes first.

G. Approved

Ed Shepard
Bureau of Land Management

4/19/04
Date

Gary Frazer
U.S. Fish and Wildlife Service

4/12/04
Date

Attachment A

Schedule for Document Review and Completion of Formal Consultation

Task	Due Date
BLM submit preliminary draft BA (including information on all treatment methods except use of herbicides)	November 15, 2004
Service provide BLM with comments on preliminary draft BA (less sections on herbicides)	December 31, 2004
BLM submit draft Ecological Risk Assessments to the Service	March 31, 2004
BLM submit preliminary draft BA (including sections related to use of herbicides) to Service	May 15, 2004
Service will notify BLM of any missing 50CFR 402.14(c) data in the preliminary draft BA	June 15 2004
BLM provides Service with needed information and Final BA	August 22, 2004
Service formulate draft Biological Opinion	November 20, 2004
BLM reviews draft Biological Opinion and provides comments to Service	December 5, 2004
Service prepare Final Biological Opinion	January 5, 2005

APPENDIX G

RESTORE NATIVE ECOSYSTEMS ALTERNATIVE

RESTORE NATIVE ECOSYSTEMS ALTERNATIVE

Submitted to the Bureau of Land Management
Sixteen-state Vegetation Management Plan
Draft Environmental Impact Statement

Revised 26 August 2002
In response to Bureau of Land Management comments
and to conform to the preferred DEIS outline

RESTORE NATIVE ECOSYSTEMS ALTERNATIVE

I. OVERVIEW

GOAL OVR 1: ECOLOGICAL INTEGRITY

Enhance the ecological integrity of BLM land by restoring natural processes, native species, ecosystem function, and resilience of plant and animal communities (see Endnote 1)

Action-OVR 1

Give approximately equal overall effort to vegetation treatments that

a. **Prevent** conditions that favor vegetation problems; and
b. **Restore** ecological integrity on sites with vegetation problems.

Action-OVR 2

Base treatments on the **best available science** and knowledge.

a. Assess the likelihood that a proposed treatment will contribute to long-term ecological integrity, citing documented, relevant case examples where possible.
b. If a treatment has not previously been attempted, cite scientific evidence that the treatment could be expected to contribute to long-term ecological integrity.

Action-OVR 3

State objectives, standards and guidelines in **clear, measurable terms**, then measure the outcomes of treatments so that they can be held accountable to long-term and treatment goals.

Action-OVR 4

Perform restoration in a **precautionary** manner, recognizing that our understanding of complex ecosystems and the consequences of our activities is limited.

Action-OVR 5

Include realistic and dedicated funding for, and an institutional commitment to, **assessment, monitoring and appropriate response** to monitoring results. Design and implement assessment (including the gathering of baseline data) and monitoring systems before activities commence.

Action-OVR 6

Encourage and facilitate **public participation** by local, regional and national stakeholders in such activities as assessment, monitoring, early detection of invading species, provision of new and scientific information, review of assessment and monitoring protocols, and analysis of alternatives for actions.

Action-OVR 7

Provide:

a. clear and significant incentives (e.g., awards, grants, budgets) for prevention of vegetation problems and restoration of ecological integrity; and
b. disincentives for activities that encourage vegetation problems and delay recovery of ecological integrity.

Action-OVR 8

Ensure that treatments are **accountable to public funding.** Rely on best available science, awarding contracts on the basis of "best value" for ecological integrity, avoid treatments of symptoms, and use local community workforces whenever feasible.

II. DEFINITIONS OF TERMS USED IN THE RESTORE NATIVE ECOSYSTEMS ALTERNATIVE

Actions Activities needed to achieve desired outcomes (goals, objectives, standards), including actions to restore or protect land health. These actions include proactive measures as well as criteria that shall be applied to guide day-to-day activities occurring on public land.

Active Restoration Treatments

Actions other than suspension of activities to restore ecological integrity or native species populations. Includes, but is not limited to

1. Road and off-road vehicle route removal
2. Culvert removal
3. Prescribed burning
4. Use of biological control introductions, cultural methods, mechanical methods, chemical methods, and prescribed fire to directly act on invasive exotic species
5. Fish and wildlife habitat rehabilitation
6. Reintroduction of extirpated species
7. Planting and care of native seeds and plants
8. Reintroduction of soil biota required by native species, when necessary
9. Other necessary activities based on priorities established in the ecological restoration assessment.

Conservation Protection of landscape, ecological, and native genetic diversity and the processes that maintain them.

Ecological Integrity The ability of an ecosystem to support and maintain a balanced, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitats within the region.

Goals Goals are broad statements of desired outcomes (e.g., maintain ecosystem health and productivity).

Historical Fire Regimes The historical range of variation of fire intervals, seasons, intensities by which native vegetation and wildlife have been shaped and to which they have adapted prior to the arrival of Euro-American settlers.

Invasive Species Exotic species shown by observation and/or scientific evidence to aggressively expand their occupancy of land, whether or not they are viewed as directly impacting economic activities, or have been listed on formal "noxious weed" lists. "Invasive species" does not include native species that increase in response to particular human activities (e.g., juniper, mesquite, sagebrush).

Objectives Objectives identify specific desired conditions for resources and have established timeframes for achievement and are usually quantifiable and measurable.

Passive Restoration Treatments

Suspension of activities that cause the loss of ecological integrity or native species populations in a specific area Passive restoration treatments may include:

1. Area , road, and off-road vehicle route closures
2. Voluntary livestock permit retirement
3. Retirement of vacant livestock allotments

4. Livestock grazing exclosures (e.g., in aggressive weed infestations, uplands "at risk" of weed infestation, riparian areas, habitat of threatened or endangered species, springs, wetlands)
5. Restrictions of logging activities
6. Restrictions of oil and gas and mineral development, including allowing expired leases to remain expired
7. Restrictions on other human activities, as relevant
8. Prescribed natural fire (i.e., allowing fires to burn under predefined circumstances)

Prevention Treatments Actions that avoid causing conditions that favor the presence of invasive species. Prevention is not limited to prevention of the *introduction* of invasive species.

Restoration Actions to regain ecological integrity.

Standards Standards are limitations placed on management activities to ensure compliance with applicable laws and regulations or to limit the discretion authority in project decision-making. Compliance with relevant standards is mandatory.

Vegetation Treatments

Actions which, based on scientific evidence, will:

(1) affect the "conservation and restoration of vegetation communities, watersheds and wildlife habitats." They include:
   (a) prevention treatments that result in
      1. measurable soil, hydrological, and vegetation changes that resist invasive exotic species; or
      2. forests with understory vegetation and fire regimes that resist dense tree growth;
   (b) prevention treatments of vegetation that pose fire hazards to important ecological values or unique ecological features; and
   (c) active and passive restoration treatments that restore native vegetation and/or conditions favorable to native communities.

(2) affect the protection of human lives or property threatened by fuels, via necessary thinning/fuels reduction, or other treatments.

Wildlands-Urban Interface The area next to a home where fires most directly threaten structures and community space where there are flammable community values. Defensible community space should be created (e.g., some thinning) within a treatment zone up to 500 meters (which includes a more intensive home-site treatment zone up to 60 meters) for firefighter safety and protection of other flammable community values.

III. VEGETATION TREATMENT PLANNING

GOAL-PLAN 1

Vegetation treatments are based on assessments of (1) the condition of vegetation; (2) major human causes of degraded conditions of the vegetation; (3) opportunities for prevention of soil disturbance and vegetation problems; (4) opportunities for conservation of native vegetation ; (5) results of past restoration treatments; and (6) comparative likelihood of treatment options for achieving long-term restoration.

Action-PLAN 1

Using existing information initially, map habitats within ecoregions, watersheds, and subwatersheds of the 16 western states:

1. key areas of native vegetation and high ecological integrity; areas of mixed native and exotic vegetation and condition; and areas of low ecological integrity
2. suitable and critical habitat for habitat-specialist terrestrial and aquatic wildlife species
3. suitable habitat for wide-ranging species (e.g., bull trout and sage grouse) that require use of extensive or temporally diverse (e.g., winter/summer habitat) areas within the ecoregion
4. hotspots of plant and wildlife biodiversity
5. habitats "at risk" of further fragmentation or degradation
6. important aquatic areas, such as riparian areas, steep/unstable slopes, wet meadows, and aquatic species' strongholds
7. areas where restoration will increase potential for habitat connectivity
8. areas that could benefit from improved management or restoration to maintain or enhance ecological integrity.

Action-PLAN 2

Consult conservation center databases and other sources of information and scientists on species occurrence. Lack of data may mean no reliable inventories have been conducted.

Action-PLAN 3

Identify spatial and temporal association of particular vegetation problems and compare and contrast with the spatial and temporal occurrence of past and continuing human activities.

Action-PLAN 4

Overlay the ecoregion habitat maps with:

1. a grazing allotment assessment with the goal of phasing out grazing in sensitive areas over time. These include degraded areas, key habitats, and areas where grazing is clearly incompatible with native vegetation and habitat recovery.
2. a logging assessment with the goal of ceasing logging in areas where there is a high risk that it would thwart the recovery of native vegetation or increase existing levels of degradation.
3. a roads and off-road vehicle routes assessment with the goal of closing and decommissioning roads and off-road vehicle routes in ecologically sensitive areas including riparian areas, unstable slopes, sensitive watersheds, and wildlife migration corridors (see Endnote 2).
4. an amphibian assessment. Avoid herbicide use in amphibian habitats, as many amphibians are highly vulnerable to herbicide applications and drift.

Action-PLAN 5

Using existing data, prepare and update every three years, maps of:

1. invasive exotic species concentrations within each watershed and subwatershed.
2. exotic species plantings on BLM lands, and, when available, adjacent private and public lands.

Action-PLAN 6

Prior to implementing site-specific vegetation treatments, prepare goals based on:

1. vegetation conditions, including invasive species concentrations
2. vulnerable wildlife and plant species and habitats
3. habitat important for threatened, endangered, and sensitive species and carnivores; connectivity for habitat-specialist wildlife
4. past and present activities within the watershed leading to vegetation problems
5. passive and active restoration needs
6. feasible restoration goals

IV. SITE SELECTION AND TREATMENT PRIORITIES

A. General

Action-PRIORITIES 1

Prioritize treatments shown to have a high probability of restoring natural processes and natural biotic communities (based on previous experiments or operational use) over treatments without this kind of documentation.

Action- PRIORITIES 2

Prioritize vegetation treatments based on scientific evidence of efficacy as follows:

1. cessation of activities that impede natural recovery (i.e., passive restoration)
2. active restoration treatments that incorporate passive restoration
3. active restoration treatments to restore ecological integrity.

Action- PRIORITIES 3

Vegetation prevention and restoration treatments must utilize:

1. a precautionary approach, which, in the face of uncertain outcomes, proceeds experimentally and cautiously
2. best available science and experiential and indigenous knowledge where applicable
3. an adaptive process that regularly incorporates revisions from monitoring and evaluation
4. a public process
5. the least intrusive techniques available to restore ecological integrity
6. the least risky interventions that are likely to provide the greatest ecological benefit
7. recovery plans for threatened and endangered species, or improvements on such plans
8. prevention strategies to reduce the need for chemical and mechanical treatments, and prescribed fire, so that the number of acres treated annually with these methods will decline over the life of the EIS.

Action- PRIORITIES 4

Herbicide treatments must be of lower priority than non-chemical treatments, and shall be used only in conjunction with:

1. elimination or reduction of the conditions that have favored the presence of invasive species
2. encouragement of conditions that resist invasive species (see Endnote 3).

Action- PRIORITIES 5

Prior to implementing a site-specific treatment:

1. identify and prioritize restoration options
2. select the least intrusive/intensive methods that will effectively move the site toward the stated goals of ecological integrity
3. identify riparian conservation areas, consisting of the riparian community and hydrological energy zones; and an outer zone that provides buffers for the riparian conservation area and considers slope stability and soil erosion.

Action- PRIORITIES 6

State for all site-specific restoration projects and activities:

1. measurable conservation and restoration objectives
2. specific indicators and measures for determining results
3. timelines for analysis of whether goals, objectives and standards have been met
4. decision making processes that will be used to respond to analysis of results.

B. Invasive Species Treatments

GOAL- PRIORITIES 1

The ecological impact of invasive species shall be minimized through conservation and restoration of native vegetation communities, watersheds and wildlife habitats.

Action- PRIORITIES 7

Give priority to two facets of the control of invasive species as defined in Executive Order No. 13112, "Invasive Species":

1. prevent the spread of invasive species from areas where they are present
2. restore native species and habitats to reduce the effects of invasive species and to prevent further invasions.

Action- PRIORITIES 8

Give treatment priority to areas in which exotic plant invasions have adverse ecological impacts on native plant communities, watersheds, and wildlife habitats.

Action- PRIORITIES 9

Develop, with the input of knowledgeable scientists and citizens, a long-term (e.g., 100-year) plan for prevention and minimization of unwanted exotic vegetation within the planning area, and restoration of ecological integrity, including native vegetation. Short-term plans (e.g., 1, 5, or 10 year horizons) will be integrated within the 100-year plan; all shall emphasize experimentation and adaptation.

Action- PRIORITIES 10

The long term vegetation management plan for integrated agency action shall include:

1. identification and lessening of the **conditions** that cause or favor the introduction, establishment, and spread of invasive species, and methods to ameliorate those conditions
2. plans for preservation or restoration of historical disturbance regimes
3. restoration of the native vegetation community, via seeding and planting, to increase resistance to invasion
4. active vegetation treatments to reduce the abundance of invasive exotic species populations.

C. Prescribed Fire, Wildfire, and Fire Suppression Treatments

GOAL- PRIORITIES 2

Natural fire regimes and native vegetation types will be restored, wherever feasible.

Action- PRIORITIES 11

Collect baseline data on historical fire regimes and plant and animal communities to use as a guide for restoration activities.

Action- PRIORITIES 1 2

Base fire management decisions on the 1995 Wildland Fire Policy, the updated 2001 Wildland Fire Policy, and current science. As required by the Fire Policy, create Fire Management Plans for every burnable acre.

Action- PRIORITIES 13

Through an open process that fully includes the public and utilizes the best available science, develop Fire Management Plans that:

1. allow certain remote wildland areas to burn under carefully prescribed conditions where ecological benefits would result
2. prescribe "Minimum Impact Suppression Tactics" where they would be most appropriate
3. prohibit aggressive soil-disturbing suppression methods where they would be damaging (e.g. bulldozers in roadless areas, chemical retardants in riparian areas)

4. determine ecological risks of fire – exotic species, population impacts - in all areas covered by plans, and carefully weigh benefits and risks as part of this process.

Action- PRIORITIES 14
Based on Fire Management Plans, use fire suppression to protect:
1. areas of high ecological values that may be at risk from exotic species invasion following fire
2. areas where human life, developed property or irreplaceable ecological values or cultural resources (e.g., rare forest types, a major portion of the population of an endangered species, or pictographs) are at stake
3. areas that should be protected until prescribed burning or other treatments can reduce excess fuels
4. important wildlife habitats (e.g., within 2 miles of sage grouse leks, big game winter ranges)

Action- PRIORITIES 15
Fire fighting shall be avoided in:
1. areas where nearby natural fire barriers such as bodies of water or rocky ridges are likely to extinguish the fire
2. Wilderness Areas, Wilderness Study Areas, roadless areas/potential wilderness areas, Wild and Scenic Rivers, and Research Natural Areas, except when fire threatens to escape from these areas or permanently impair ecological or cultural values.

Action- PRIORITIES 16
Mechanical fire suppression (i.e., with bulldozers) shall be avoided in riparian zones, steep slopes and other ecologically sensitive areas..

D. Fuels Reduction

GOAL- PRIORITIES 3
Human lives and property will be protected from wildfire and natural processes will be restored.

Action- PRIORITIES 17
Distinguish between fuels treatments intended to restore ecological integrity and those primarily intended to protect property and human life.

Action- PRIORITIES 18
Fuels reduction funds under the National Fire Plan shall be used:
1. only in the wildlands urban interface to protect lives and property
2. for strategic fire management planning and firefighter training to maximize the safety, ecological soundness, and effectiveness of fire and fuels management actions including prescribed fire, wildland fire use, and fire suppression.

Action- PRIORITIES 19
Fuels reduction shall, except for restoration or conservation necessity:
1. minimize or avoid road construction and reconstruction
2. avoid roadless areas, old growth, endangered species habitat, riparian areas, ecological sensitive areas and other areas of high ecological integrity
3. avoid habitat of threatened and endangered species.

Action- PRIORITIES 20
Fuels reduction treatments shall not:
1. increase motorized vehicle use or livestock access
2. supply biomass plants
3. increase fire risk through accumulation of activity fuels
4. include chaining

5. include clearcutting
6. limit native plant recovery through chipping or ground disturbing activities.

Action- PRIORITIES 21

Use positive economic incentives that encourage ecologically based restoration activities and eliminate incentives that encourage activities that are ecologically degrading.

1. contracts for fuels reduction/thinning for wildlands urban interface or restoration shall not include:
    a) commercial timber sales
    b) "goods for services" stewardship contracts
2. all fuel reduction projects shall be paid for by appropriated dollars and any material of commercial value shall be sold in a separate contract and all revenues shall be returned to the treasury or used to support monitoring.

V. PREVENTION VEGETATION TREATMENTS

A. General

Action-PREVENTION 1

The BLM shall not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species unless the agency has determined and made public its determination that the public benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.

B. Invasive Species

Action- PREVENTION 2

Develop and implement comprehensive, science-based protocols designed to prevent the spread of invasive species in relation to all activities on BLM lands that have been identified in the scientific literature as primary facilitators of the establishment and spread of invasive species, watershed degradation, and loss of native species.

1. Livestock Grazing

GOAL- PREVENTION 1

The introduction, establishment, and spread of invasive species due to livestock grazing shall be minimized.

Action- PREVENTION 3

Reduce spread of invasive weeds caused by domestic livestock grazing:

1. retire domestic livestock grazing permits at earliest opportunity where grazing has been found to promote invasion or persistence of invasive species
2. prioritize invasives prevention and restoration activities for areas where domestic livestock grazing has been permanently ended
3. manage livestock movement patterns to insure animals are not moving seeds of invasive species from infested to uninfested areas
4. suspend livestock grazing on non-cohesive soils in perennially saturated meadows.
5. manage livestock grazing to favor native species
6. avoid grazing in systems still containing a strong component of native perennials, biological soil crusts, or other features known to act as natural barriers to invasion or increase of invasive exotic species.

2. Roads and Off-Road Vehicles

GOAL- PREVENTION 2
Invasive species introduction, establishment and spread due to road, fire break, and off-road vehicle route construction, use, and maintenance shall be minimized.

Action- PREVENTION 4
Develop GIS maps and databases of all system (authorized and constructed) and non-system (user-created) roads and routes.

Action-_PREVENTION 5
Precede all road or off-road vehicle route reconstruction, and any consideration of adding existing or illegal user-created roads and off-road vehicle routes to the transportation system, by NEPA analyses of their impacts, including potential to facilitate the spread of invasive species into native ecosystems.

Action- PREVENTION 6
Close or restrict non-essential, designated routes for motorized vehicle travel in areas of high risk for spread of invasive species.

Action- PREVENTION 7
Implement measures that reduce the likelihood of weed seed dispersal, such as educating equipment operators, implementing appropriate protocols for vehicle and equipment washing, restricting recreational access and seasonal travel. Consider restricting road grading activities in areas with high populations of invasive species.

Action- PREVENTION 8
Implement full area closures that prohibit all motorized travel on lands outside of designated and NEPA analyzed transportation system roads and off-road vehicle routes.

Action- PREVENTION 9
Identify and designate for obliteration non-essential system and non-system roads and off-road vehicle routes that do not comply with native vegetation protection goals.

Action- PREVENTION 10
Cease new road construction and most road reconstruction in riparian areas

Action- PREVENTION 11
Reclaim obliterated roads to native vegetation.

3. Fire Suppression

Action-_PREVENTION 12
Utilize Minimum Impact Suppression Techniques and fully reclaim fire lines with native vegetation after fire emergency situations have ended, in order to prevent the spread of invasive species into the disturbed fire line corridors and to prevent the use of fire line corridors as illegal off-road vehicle travelways.

4. Wildland-Urban Interface

Action- PREVENTION 13
Home-site treatments in the wildland-urban interface (e.g., thinning, pruning, and mowing of vegetation) must be undertaken primarily within a 20 - 60 meter (66-200 feet) intensive treatment zone where fires most directly threaten structures and human life.

Action- PREVENTION 14

Defensible community space that may include public and private lands may be created within an additional treatment zone up to 500 meters (which includes the 60 meter home-site treatment zone) for fire fighter safety and protection of other flammable community values.

Action- PREVENTION 15

Treatments to create defensible space may include thinning small diameter trees, pruning, mowing, roof cleaning , as well as replacement of flammable landscape and building materials.

Action- PREVENTION 16

Long-term maintenance activities within the wildland-urban interface (i.e., prescribed burning, mechanical brush removal, etc.) as well as monitoring plans must be considered and a funding commitment secured before any action is undertaken.

Guideline- PREVENTION 1

Management of the wildland-urban interface zone should be a cooperative partnership between relevant agencies, tribes, communities, and homeowners. Cooperation shall extend from the initial risk assessment and following through to future maintenance and should account for appropriate access to structures for fire fighting as well as fire resistant landscaping and consideration of construction standards and proper zoning laws for all land ownerships.

Action- PREVENTION 17

Restoration priorities must be identified through a restoration assessment before any restoration fuels reduction activities take place.

5. Timber

GOAL- PREVENTION 3

The introduction, establishment, and spread of invasive species due to timber sales shall be minimized.

Action- PREVENTION 18

Maintain old-growth vegetation communities as bulwarks of vegetational resistance to invasion; minimize disturbance of old-growth or late seral vegetation communities; and, whenever possible, maintain intact forest canopies adjacent to areas such as roads and clearcuts where invasive species are abundant.

Action- PREVENTION 19

Design and plan timber sales for maximum prevention of introduction, spread, and establishment of invasive species, including pathogens.

6. Altered Hydrological Regimes

GOAL- PREVENTION 4

The introduction, establishment, and spread of invasive species due to altered flow regimes of rivers and streams will be minimized.

Action- PREVENTION 20

Prioritize treatments of riparian areas where restoration is likely to be successful; e.g., areas where the natural historic flow regime is extant.

Action PREVENTION 21

Restore native historical flow regimes whenever it is possible to do so.

7. Oil, Gas, and Mineral Exploration and Development

GOAL- PREVENTION 5
The introduction, establishment, and spread of invasive species due to oil, gas, and mineral exploration and development will be minimized.

Action- PREVENTION 22
Prohibit surface disturbance associated with oil and gas exploration, development, and production activities in areas with

1. endangered, threatened, candidate, sensitive, or rare plant species
2. steep slopes.

Action-PREVENTION 23
Minimize surface disturbance associated with oil and gas exploration, development, and production activities in areas with sensitive soils.

Action- PREVENTION 24
In areas where seismic exploaration activities are permitted best available technologies must be used (i.e. helicopter shot-hole technologies over the use of 65,000 pound thumper trucks.

Action- PREVENTION 25
Locate wells and associated roads and pipelines on slopes less than 25% to avoid or minimize surface disturbance; on slopes greater than 25%, prohibit surface disturbing activities

Action- PREVENTION 26
Keep removal and disturbance of vegetation to a minimum through construction site management (e.g. using previously disturbed areas and existing easements, limiting equipment/materials storage and staging area sites etc.) on both individual well locations and within oil and gas project areas.

Action- PREVENTION 27
Limit vehicular traffic to the running surface of roads and well locations as authorized in Application's for Permit to Drill (APD's) and Right of Ways (ROWs) thus prohibiting all traffic on two-tracks and trails near oil and gas well location and within oil and gas project areas.

Action- PREVENTION 28
Require that all gravel and other surfacing materials used for the project are free of noxious weeds.

Action- PREVENTION 29
Complete a survey for any and all endangered, threatened, candidate, sensitive, or rare plant species prior to allowing any surface-disturbing activities involved with oil and gas exploration, development, and production activities.

Action- PREVENTION 30
Adopt a "No Net Loss" policy for all special status plant species.

Action- PREVENTION 31
Each operator must submit a Surface Use Plan containing appropriate erosion control and revegetation measures (e.g., reintroduction of biological soil crust or mycorrhizae) with each APD request.

Action- PREVENTION 32
Grading and landscaping shall be used during and after construction activities are completed to minimize slopes, and water bars shall be installed on disturbed slopes in areas with unstable soils where seeding alone may not adequately control erosion.

Action- PREVENTION 33
Upon the completion of the drilling phase, require immediate reclamation of all portions of the pad that can be reclaimed using the soils originally removed during construction.

Action- PREVENTION 34
With each APD request, the oil and gas operators must submit a reclamation plan that includes, but shall not be limited to:

1. identification of lands to be disturbed
2. detailed description of the baseline condition and resources on the land including existing uses, soil characteristics, slope, topography, vegetative cover, and productivity
3. methods to control erosion
4. plans to revegetate and restore the areas disturbed
5. measures that address steep slopes, sensitive soils, recontouring requirements, short-term seedbed preparation measures, seeding mixtures and methods, and long-term reclamation goals
6. steps to be taken to comply with federal, state, and local environmental laws, regulations, and policies.

8. Disturbance to Biological Soil Crusts

GOAL- PREVENTION 6
Biological soil crusts shall be maintained as a partial shield preventing establishment or spread of invasive exotic species (See Endnote 4).

Action- PREVENTION 35
Using existing data, map and describe the presence and integrity of biological soil crusts at the ecoregion and watershed levels within the 16 western states; locally develop maps at the subwatershed level.

Action- PREVENTION 36
Prepare and implement a general plan for damaged biological soil crusts.

Action- PREVENTION 37
Prohibit livestock grazing for at least five years following a fire in areas capable of maintaining biological soil crusts. Return of livestock will be delayed past five years if significant recovery of the biological soil crust has not occurred.

C. Prevention of Excess Fuels

Goal-PREVENTION 7
Shrub and tree establishment shall be maintained at historical densities to prevent excess fuels.

Action-PREVENTION 38
Reduce or eliminate livestock grazing in forests and shrublands where:

1. historical grass and forb competition to tree and shrub seedlings density has been or can be diminished by grazing
2. historical understory necessary to carry "cooler" fires has been or can be diminished by grazing.

Action- PREVENTION 39
Exclude livestock for at least five years from forest and shrubland areas following fuels reduction treatments (e.g., burning, thinning), and until pre-determined native vegetation composition, density, and ground cover have been attained.

Action- PREVENTION 40
Allow wildland fire and consider prescribed burning in order to maintain capacity for cooler, understory fires within shrublands and forests.

VI. RESTORATION VEGETATION TREATMENTS

A. Direct Treatments of Invasive Species

Action-RESTORATION 1
Use the least intrusive/extensive/risky vegetation treatment methods to enhance wildlife habitat and populations.

Action- RESTORATION 2
Analyze potential effects of site-specific treatments on an array of species; reliance on assessments of effects only on umbrella species is not sufficient (see Endnote 5).

Action- RESTORATION 3
Direct treatments of invasive species shall be part of an over-all ecologically based restoration plan and may include:

1. Biological control
2. Cultural (manual) practices
3. Mechanical treatments
4. Chemical treatments
5. Prescribed fire

Action- RESTORATION 4
Base the selection of direct treatment methods on:

a. ecological priorities for restoration rather than potential economic benefits
b. size of the proposed treatment area, its location, and the biology of the target invasive species.

Action- RESTORATION 5
Except for treatment of small infestations without motorized equipment, prescribe direct treatments within designated wilderness or wilderness study areas only in conjunction with efforts to halt avoidable spread of invasive species into the wilderness from outside these areas.

Guideline- RESTORATION 1
Adopt the Carhart Model (Arthur Carhart National Wilderness Training Center) for completing minimum requirement analyses and minimum-impact tool analysis. The model assists managers in making administrative decisions concerning wilderness.

Action- RESTORATION 6
Prioritize nonchemical methods, unless shown to be ineffective, over chemical methods.

Action- RESTORATION 7
Small infestations have higher priority for active restoration treatments than large-scale infestations, with the exception of biological control. Use seasonal employees to detect and treat small infestations.

Action- RESTORATION 8
Use only those biological control agents that have been demonstrated to pose no threat to native species.

Action- RESTORATION 9

Use cultural treatments that have been shown effective in restoring native vegetation in scientific studies (e.g., use of properly timed fire, properly timed and managed goat grazing, mulching, and hand pulling) and conduct operational research to develop new, effective cultural treatments.

Action- RESTORATION 10

Plant and seed appropriate native species to compete with exotic species.

Action- RESTORATION 11

Use mechanical treatments that have been shown to be effective in restoring native vegetation in scientific studies (e.g., mowing, spot fire (flamer), mastication, weed eaters, mulching, and weed wrenches) and conduct operational research to develop new, effective mechanical treatments.

Action- RESTORATION 12

For chemical treatments, use application methods that minimize exposure to people, wildlife, and native plants. Spot treatment methods shall be preferred over broadcast methods.

Action- RESTORATION 13

Do not use broadcast herbicide treatments within 500 feet of endangered, threatened, candidate, sensitive, or rare plants. If herbicides are necessary for protection of a rare species, allow only application methods that apply herbicides only to the target plants.

Action- RESTORATION 14

Avoid application of herbicides and prohibit broadcast spraying in riparian conservation areas. Avoid application of herbicides (e.g. atrazine) with adverse effects on aquatic species and amphibians.

Action-RESTORATION 15

Prohibit the use of herbicides in known aquatic and terrestrial amphibian habitat, including breeding, rearing, and overland dispersal areas.

Action- RESTORATION 16

Only herbicides that minimize adverse effects on environmental and human health, based on knowledge of all ingredients in the formulation, shall be utilized for chemical control.

Action- RESTORATION 17

Prohibit use of sulfonylurea herbicides and other acetolactate synthase-inhibiting herbicides due to their demonstrated ability to damage off-site native and crop species.

Action- RESTORATION 18

Design treatments to account for wildlife habitat needs, for instance, by the timing and location of activities. Avoid treatments during nesting season for migratory birds, and during identified sensitive periods for wildlife (e.g., critical wintering habitat for big game or sage grouse).

B. Prescribed Fire

Action- RESTORATION 19

Use prescribed fire to restore native vegetation, historical fire regimes, and native ecosystem; and to mitigate human safety threats, but only in concert with a restoration assessment with clear objectives, and where it will not increase invasive species.

Action- RESTORATION 20

Consideration of the following must be documented prior to prescribed burns, if relevant:

1. long-term damage to biological soil crusts

2. soil erosion through wind and runoff events
3. long-term loss of nutrients from already nutrient-deficient landscapes
4. loss of populations and habitat of special status species
5. risk of spread of invasive species
6. the levels of nuclear testing radionuclides in the immediate and adjacent area
7. interrelation between prescribed burning projects on adjacent Federal/state lands
8. indigenous uses of plants that may be impacted.
9. impacts on air quality
10. lethal effects on mature ponderosa pine, particularly from fire damage of roots

Action- RESTORATION 21

Burned areas (natural or prescribed) must be protected from livestock grazing for at least five years and until measurable recovery criteria are met.

Action- RESTORATION 22

Prescribed burning teams shall:

1. use existing roads
2. limit ground disturbance
3. address risk of fire spreading beyond the project area and onto surrounding lands.

C. Fuels Reduction

Action- RESTORATION 23

Fuels reduction to restore natural fire processes shall be based on comprehensive restoration assessments with clear objectives, in conjunction with other active or passive methods.

Action- RESTORATION 24

Following fire, all standing trees shall be left for wildlife habitat, soil stability, and nutrient cycling, except where removal is necessary to maintain public safety or to restore ecological integrity (e.g., possible removal of small green trees that "should" have burned, so that future fires can burn more naturally).

D. Fire Suppression

Action- RESTORATION 25

Minimize introduction of invasive species during and after fire suppression operations:

1. clean equipment of invasive species seeds before moving equipment off roads to build fire breaks
2. seal all firebreaks to prevent off-road vehicle access.

Action- RESTORATION 26

Minimize post-fire disturbance to burned areas to allow natural recovery.

Action- RESTORATION 27

Monitor all fire camps and helicopter spots for invasive species following fire.

E. Forage Enhancement

Action- RESTORATION 28

Conduct forage enhancement projects only if they incorporate ecological principles to encourage native species, and will not result in any net loss of native plant communities.

VII. REVEGETATION

Action-REVEGETATION 1

In revegetation efforts, whenever it is possible to do so, use native seed and seedlings that have been grown from seeds of locally adapted populations.

Action- REVEGETATION 2

If native seeds/plants are not available, revegetation projects will rarely be undertaken until native plant seed or plants become available. Non-native plant species will be used only in extremely degraded/severely altered systems as an intermediate step toward/placeholder for native restoration, accompanied by a full commitment to complete restoration of native species. This commitment must include funds set aside as part of the project, with specific deadlines for accomplishment.

Action- REVEGETATION 3

When reseeding with non-native species, certification must be provided that only species that have been documented as non-persistent are present in the seeding mixture.

Action- REVEGETATION 4

Assure availability of native seed and plants:

1. establish BLM contracting systems that will provide growers the necessary assurance their native, locally-adapted seed/plants will be purchased if grown
2. establish sufficient storage facilities for native seeds for major revegetation efforts.

Action- REVEGETATION 5

Determine, in landscape, watershed, and subwatershed vegetation assessments, the feasibility of providing habitat for wildlife and plant species that have been extirpated or nearly extirpated.

Action- REVEGETATION 6

Prepare a public report on potential reintroduction of extirpated species, including foreseeable human activities or developments that would foreclose options for such reintroductions.

Action- REVEGETATION 7

Collaborate with federal, state, local and private land managers to reduce sale and planting of exotic invasive species, and increase availability and use of appropriate native species, with particular attention to inholdings and other lands adjacent to BLM lands.

Action- REVEGETATION 8

Focus invasive species public education programs on 10-20 of the most ecologically problematic local invasive species and those that have the potential to invade a given District. Include information about how these species are introduced to public lands.

Action- REVEGETATION 9

Following fire or other disturbances, do not propose reseeding unless it can be shown that natural regeneration is unlikely. Use native species unless they are not available. Always use certified weed-free seed.

VIII. MONITORING AND EVALUATION

Action-MONITOR 1

Before resources are committed to modify a plant community, gather baseline data to reflect existing conditions. If treatments are initiated, data shall be collected to substantiate whether or not any of the

goals, objectives, and standards have been met. If baseline and post-treatment evaluation monies are not available, then the project shall not be approved (see Endnote 6).

Action-MONITOR 2

Monitoring must be used to:

1. inventory baseline conditions at the landscape, watershed, subwatershed, and project site levels
2. measure whether positive goals for native ecosystem recovery, conservation, and integrity are being attained
3. track biodiversity and health using an increaser/decreaser species procedure (including biological soil crusts, wildlife, and endemic/sensitive species).
4. practice precaution, retain flexibility, and respond to change, unforeseen harm, failure to reach objectives, and/or new information
5. quantify invasive species population changes
6. establish success/problems with specific prevention and restoration treatments in a variety of sites.

Action-MONITOR 3

Monitoring and evaluation of vegetation treatments shall:

1. relate to the clearly stated objectives of all restoration projects
2. be an integral component of each restoration project
3. be incorporated into the essential costs of each project
4. use scientific principles of experimental design including replication and measurements from untreated control areas for comparison with treated locations
5. use a process responsive to all-party and scientific input
6. encourage involvement of local, regional and national stakeholders
7. be documented in a sixteen-state central database with assessments, objectives, monitoring procedures, and analyses in comparable formats
8. outline clear procedures for responding to monitoring and evaluation results

Action-MONITOR 4

Monitoring methods shall be:

1. Relevant: evaluates progress toward stated objectives
2. Sensitive: quickly detects change, shows trends, identifies critical features
3. Available: inexpensive, easily applied
4. Measurable: accurately quantifiable with acceptable methods
5. Defensible: minimally subject to individual bias
6. Verifiable: allows others applying the same methods to achieve similar results
7. Inclusive: avoids reductionism, where feasible
8. Scheduled: monitoring interval firmly scheduled.

Action-MONITOR 5

Goals, objectives, and standards must be written for all projects tiered to this EIS. All projects must be monitored to determine if their goals, objections, standards, and guidelines are being met on schedule.

Action-MONITOR 6

Objectives and standards must be written in such a manner as to be measurable with concrete ecosystem indicators. Reliance on "professional judgment" without evidence should be minimized, so that conclusions and ecosystem conditions can be independently verified.

Action-MONITOR 7

Each District must prepare an annual monitoring report of all vegetation restoration projects (passive and active). These reports should be available at a central BLM location (see Endnote 7).

Action-MONITOR 8
Each District must annually report whether goals, objectives, and standards are being met. For those that are not being met, indicate plans for meeting them.

Action-MONITOR 9
All proposals to undertake a vegetation restoration activity must include a description of the monitoring that will be necessary to determine the compatibility of the activity with specific goals, objectives, and standards; and the treatment efficacy.

Action- MONITOR 10
Require the submission of an annual monitoring plan at or near any and all locations disturbed by oil and gas activities before granting approval of an Application for Permit to Drill.

Action-MONITOR 11
Annually monitor for five years all firelines, fire camps, helicopter spots, and fire retardant-treated areas for invasive species; eliminate introduced invasive species.

Action- MONITOR 12
Monitor progress toward attainment of long term health and integrity of the watershed, aquatic, riparian, native vegetation and soil resources.

IX. TRIBAL RELATIONS FOR VEGETATION TREATMENTS

GOAL-TRIBES 1
Native American Indian concerns and issues relative to vegetation prevention and restoration treatments are addressed and mitigated in full collaboration with Native Tribal people.

Action-TRIBES 1
Consultation and collaboration with Native Tribes shall take place throughout the process of developing and implementing this EIS in accordance with Executive Order No. 13084, Consultation and Coordination with Indian Tribal Governments.

Action-TRIBES 2
Contact Native Tribal representatives from Tribal governments and organizations when vegetation treatments are being planned. Give particular attention to consultation and collaboration with local Tribal people when activities may affect Native cultural resources, hunting, fishing and gathering areas, sacred sites, or Tribal trust lands.

Action-TRIBES 3
Analyze treatment proposals pursuant to Executive Order No. 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.

Action-TRIBES 4
In collaboration with Tribal people, identify culturally significant plants used for food, basketweaving and other fibers, medicine, and ceremonial purposes.

Action-TRIBES 5
Develop protocols for enhancement and protection of culturally significant plants :

1. utilize traditional indigenous knowledge and wisdom to protect and enhance native vegetation communities, native resources, and ecosystems.
2. prioritize treatments that will enhance and preserve culturally significant plants and animals.

3. use minimal impact vegetation treatments where culturally significant species are known to occur. Vegetation treatments will not result in net loss of native species of importance to indigenous people for subsistence or cultural purposes.

Action-TRIBES 6

Establish herbicide-free zones to protect culturally significant plant and wildlife resources.

Action-TRIBES 7

Provide notification to Indian communities of the exact locations, dates, and times that herbicide applications will take place, via letters of notification and posting in prominent locations (such as community bulletin boards and local post offices).

Action-TRIBES 8

Monitor the impacts of different vegetation treatments upon the viability and health of culturally significant plants and animals. Adapt treatment approaches as necessary to ensure culturally significant plant and animal resources are protected for seven generations.

X. COORDINATION, EDUCATION, AND PUBLIC AWARENESS

Action-CEPA 1

Identify activities that prevent, minimize, or reverse (as well as facilitate) the introduction, establishment, spread, and reinvasion of specific invasive exotic plant species (e.g., cheatgrass, ventanata, starthistle) on BLM lands.

Action- CEPA2

Incorporate findings of the analysis (CEPA-1) in all site-specific treatment decisions.

Action- CEPA 3

Develop and maintain a central web site featuring prevention and passive and active restoration treatments, including:

1. scientific literature on treatment outcomes of relevance to BLM lands
2. BLM projects that have resulted in reestablishment of native vegetation, reintroduction of extirpated species, increase in sensitive species populations, reduction in acres needing restoration treatments, or reestablishment of natural fire regimes
3. successful BLM projects or programs to alter activities that have facilitated the introduction, establishment and spread of invasive species.

Action- CEPA 4

Establish annual awards to BLM employees, Districts, and inholding landowners for accomplishments such as:

1. successful passive and active restoration of native vegetation
2. equality of effort to prevention and restoration treatments
3. exemplary monitoring
4. significant involvement of NGOs, students, and other volunteers in conservation and restoration activities..

Action- CEPA 5

Eliminate funding based on acres of vegetation directly treated the previous year without (a) documented alteration of the conditions that favored the presence of the vegetation that was directly treated and (b) restoration programs to restore the site to native vegetation.

Guideline- CEPA 1

Offer simple invasive exotic species reporting forms to BLM lands visitors in order to encourage the reporting of locations in which particular invasive species are present

Action- CEPA 6

Educate the public, including owners of lands neighboring BLM lands, about:

1. the natural role of fire and protecting their homes from fire through the Fire Wise Program
2. prevention of invasive species introduction, establishment, and spread.

Endnotes

1. Vegetation (and thus ecosystem) problems on BLM lands in sixteen western U.S. states include fragmentation; simplified ecosystems; invasive exotic species; altered fire regimes; compacted and otherwise heavily-disturbed soils; and impaired watersheds, with disturbed upland and riparian systems.

2. The three most common activities on public lands managed by the BLM that continue to contribute to declining watershed health are:
   - *Livestock grazing*, which has caused severe, widespread, long-lasting damage to soils, vegetation, riparian areas, streams, and associated species;
   - *Roads*, which damage water quality, riparian areas, the quantity and timing of water flows, aquatic and riparian flora and fauna, and the overall hydrologic and ecological functions of watersheds; and
   - *Logging*, which has contributed to degradation of water quality, riparian areas, soils, vegetation, and aquatic resources.

   These activities lead to elevated sedimentation, degraded soils, degraded riparian areas, and altered stream flows within much of the BLM-managed landscape. Fire in watersheds, a natural process, plays a far smaller role in watershed degradation than these activities.

3. This prioritization is essential, as herbicides can (1) have numerous adverse toxic effects on workers; nearby residents; beneficial soil organisms; and native plant, aquatic, terrestrial and avian species; (2) simplify the vegetation community; and (3) render the treated site more vulnerable to return of invasive species. Herbicides alone do not address the conditions that favor the introduction, establishment and spread of invasive species, and yet they are often used as stand-alone technological "fixes."

4. These crusts of lower plants and cyanobacteria cover soil surfaces between individual plants in healthy arid grasslands, shrublands, and dry woodlands. While they fix nitrogen, increase soil fertility, improve water infiltration, stabilize soils, and enhance the establishment of vascular plants, they also may provide a shield that reduces or prevents establishment and spread of exotic species. Biological soil crusts are particularly susceptible to damage from physical disturbance.

5. An example of the insufficiency of analysis for effects solely on an umbrella species involves sagebrush canopy "thinning" for sage grouse. This may negatively impact nesting cover for migratory bird species of concern.

6. There is an obvious, admitted, ongoing, and institutional failure to adequately monitor, survey, and document the impacts of human activities on habitats, native vegetation, and native wildlife on federal public lands. Even when monitoring has occurred, land managers have rarely translated the findings into management improvements. Good intentions and monitoring plans have been insufficient to direct sufficient funding, staff, or attention to the outcomes of vegetation and other restoration treatments, among other human activities. It is essential that both the continuation and initiation of vegetation restoration activities be dependent upon prior adequate baseline and post-treatment monitoring. "We do what we get funded for" is neither a legally sufficient nor an ecologically responsible approach to the required, continuous, finding of compatibility of treatment activities with the goals, objectives, standards, and guidelines of this EIS.

7. Monitoring needs to be documented so that it can be independently reviewed by non-BLM scientists, the scientifically literate public, and others who are concerned about the ecological health of the nation's federal public lands.

APPENDIX H

SPECIAL STATUS SPECIES LIST

APPENDIX H

SPECIAL STATUS SPECIES LIST

Common Name	Scientific Name	State	Class	Status[1]
A Caddisfly	*Farula constricta*	OR	Insect	BS
Adder's-tongue	*Ophioglossum pusillum*	OR	Plant	BS
Agave, Arizona	*Agave arizonica*	AZ	Plant	FE
Agave, Murphey	*Agave murpheyi*	AZ	Plant	BS
Agave, Santa Cruz Striped	*Agave parviflora parviflora*	AZ	Plant	BS
Agoseris, Pink	*Agoseris lackschewitzii*	ID	Plant	BS
Albatross, Short-tailed	*Phoebastris albatrus*	AK, CA	Bird	FE
Alkaligrass, Howell's	*Puccinellia howelli*	CA	Plant	BS
Alkaligrass, Lemon's	*Puccinellia lemmonii*	CA	Plant	BS
Alkaligrass, Parish's	*Puccinellia parishii*	CA, NM	Plant	BS
Alpine-aster, Tall	*Oreostemma elatum*	CA	Plant	BS
Alpine-parsley, Trotter's	*Oreoxis trotteri*	UT	Plant	BS
Alumroot, Duran's	*Heuchera duranii*	CA	Plant	BS
Amaranth, California	*Amaranthus californicus*	MT	Plant	BS
Ambersnail, Kanab	*Oxyloma haydeni kanabensis*	AZ, UT	Snail	FE
Ambrosia, San Diego	*Ambrosia pumila*	CA	Plant	FE
Amole, Purple	*Chlorogalum purpureum purpureum*	CA	Plant	FT
Amphipod, Malheur Cave	*Stygobromus hubbsi*	OR	Crustacean	BS
Amphipod, Noel's	*Gammarus desperatus*	NM	Crustacean	PE
Angelica, King's	*Angelica kingii*	ID	Plant	BS
Angelica, Rough	*Angelica scabrida*	NV	Plant	BS
Apple, Indian	*Peraphyllum ramosissimum*	ID	Plant	BS
Arrowhead, Sanford's	*Sagittaria sanfordii*	CA	Plant	BS
Aster, Gorman's	*Aster gormanii*	OR	Plant	BS
Aster, Pygmy	*Aster pygmaeus*	AK	Plant	BS
Aster, Red Rock Canyon	*Ionactis caelestis*	NV	Plant	BS
Avens, Mountain	*Senecio moresbiensis*	AK	Plant	BS
Baccharis, Encinitis	*Baccharis vanessae*	CA	Plant	FT
Balloonvine	*Cardiospermum corindum*	AZ	Plant	BS
Balsamroot, Big-scale	*Balsamorhiza macrolepis macrolepis*	CA	Plant	BS
Balsamroot, Large-leaved	*Balsamorhiza macrophylla*	MT	Plant	BS
Balsamroot, Silky	*Balsamorhiza sericea*	CA	Plant	BS
Balsamroot, Woolly	*Balsamorhiza hookeri lanata*	CA, OR	Plant	BS
Barberry, Kofa Mtn.	*Berberis harrisoniana*	AZ	Plant	BS
Barberry, Nevin's	*Berberis nevinii*	CA	Plant	FE
Bartonberry	*Rubus bartonianus*	OR	Plant	BS
Bat, Allen's (Mexican) Big-eared	*Idionycteris phyllotis*	AZ, CO, NM, NV, UT	Mammal	BS
Bat, Big Brown	*Eptesicus fuscus*	NV	Mammal	BS
Bat, Big Free-tailed	*Nyctinomops macrotis*	CO, NM, NV, UT	Mammal	BS
Bat, Brazilian Big-eared	*Tadarida brasiliensis mexicana*	UT	Mammal	BS
Bat, Brazilian Free-tailed	*Tadarida braziliensis*	NV	Mammal	BS
Bat, California Leaf-nosed	*Macrotus californicus*	AZ, CA, NV	Mammal	BS

Common Name	Scientific Name	State	Class	Status[1]
Bat, Greater Western Mastiff	*Eumops perotis californicus*	CA, NM, NV	Mammal	BS
Bat, Hoary	*Lasiurus cinerus*	NV	Mammal	BS
Bat, Lesser Long-nosed	*Leptonycteris curosoae yerbuensis*	AZ, NM	Mammal	FE
Bat, Mexican Long-nosed	*Leptonycteris nivalis*	NM	Mammal	FE
Bat, Mexican Long-tongued	*Choernycteris mexicana*	AZ, NM	Mammal	BS
Bat, Occult Little Brown (Arizona)	*Myotis lucifugus occultus*	AZ, NM	Mammal	BS
Bat, Pale Townsend's Big-eared	*Plecotus townsendii pallescens*	NM	Mammal	BS
Bat, Pallid	*Antrozous pallidus*	CA, NV	Mammal	BS
Bat, Pocketed Free-tailed	*Nyctinomops femorosaccus*	AZ	Mammal	BS
Bat, Silver-haired	*Lasionycteris noctivagans*	NV	Mammal	BS
Bat, Spotted	*Euderma maculatum*	AZ, CA, CO, ID, MT, NM, UT, WY	Mammal	BS
Bat, Townsend's Big-eared	*Corynorhinus townsendii*	CO, NM, OR, UT	Mammal	BS
Bat, Townsend's Western Big-eared	*Corynorhinus townsendii townsendii*	CA, ID, MT, NV, OR, UT, WY	Mammal	BS
Bat, Underwood Mastiff	*Eumops underwoodi*	AZ	Mammal	BS
Bat, Western Pipistrell	*Pipistrellus hesperus*	NV	Mammal	BS
Bat, Western Pipistrell	*Pipistrellus hesperus*	ID	Mammal	W
Bat, Western Red	*Lasiurus blossevillii*	NM, NV, UT	Mammal	BS
Beaked-rush, California	*Rhynchospora californica*	WY	Plant	BS
Bear, Grizzly (Brown)	*Ursus arctos horribilis*	ID, MT, OR, WY	Mammal	FT
Beardtongue, Absaroka	*Penstemon absarokensis*	WY	Plant	BS
Beardtongue, Alamo	*Penstemon alamosensis*	NM	Plant	BS
Beardtongue, Bashful	*Penstemon pudicus*	NV	Plant	BS
Beardtongue, Blue-leaf	*Penstemon glaucinus*	OR	Plant	BS
Beardtongue, Broad-beard	*Penstemon angustifolius dulcis*	UT	Plant	BS
Beardtongue, Closed-throated	*Penstemon personatus*	CA	Plant	BS
Beardtongue, Cordelia	*Penstemon floribundus*	NV	Plant	BS
Beardtongue, Death Valley (Amargosa Valley Beardtongue)	*Penstemon fruticiformis amargosae*	CA, NV	Plant	BS
Beardtongue, Degener	*Penstemon degeneri*	CO	Plant	BS
Beardtongue, Franklin's	*Penstemon franklinii*	UT	Plant	BS
Beardtongue, Gibbens'	*Penstemon gibbensii*	CO, UT, WY	Plant	BS
Beardtongue, Harrington	*Penstemon harringtonii*	CO	Plant	BS
Beardtongue, Lapoint	*Penstemon goodrichii*	UT	Plant	BS
Beardtongue, Mount Trumbull	*Penstemon distans*	AZ	Plant	BS
Beardtongue, Narrowleaf	*Penstemon angustifolius*	MT	Plant	BS
Beardtongue, Nevada Dune	*Penstemon arenarius*	NV	Plant	BS
Beardtongue, Pahute Mesa	*Penstemon pahutensis*	NV	Plant	BS
Beardtongue, Parachute (Parachute Penstemon)	*Penstemon debilis*	CO	Plant	C
Beardtongue, Penland	*Penstemon penlandii*	CO	Plant	FE
Beardtongue, Sand-loving	*Penstemon ammophilus*	UT	Plant	BS
Beardtongue, Sheep Range	*Penstemon petiolatus*	AZ	Plant	BS
Beardtongue, Stemless	*Penstemon acaulis acaulis*	WY	Plant	BS
Beardtongue, Stephen's	*Penstemon stephensii*	CA	Plant	BS
Beardtongue, Thread-leaved	*Penstemon filiformis*	CA	Plant	BS

Common Name	Scientific Name	State	Class	Status[1]
Beardtongue, Tunnel Springs	*Penstemon concinnus*	NV	Plant	BS
Beardtongue, Uinta Basin	*Penstemon whippleanus*	MT	Plant	BS
Beardtongue, Whipple's	*Penstemon whippleanus*	MT	Plant	BS
Beardtongue, White River	*Penstemon scariosus albifluvis*	CO, UT	Plant	C
Beardtongue, White-margined	*Penstemon albomarginatus*	AZ, CA, NV	Plant	BS
Beardtongue, Yellow Two-toned	*Penstemon bicolor bicolor*	NV	Plant	BS
Bear-poppy, Dwarf	*Arctomecon humilis*	UT	Plant	FE
Bear-poppy, White (Merriam Bear-poppy)	*Arctomecon merriamii*	CA, NV	Plant	BS
Bear-poppy, White (Merriam Bear-poppy)	*Arctomecon merriamii*	UT	Plant	FE
Beavertail, Short-joint	*Opuntia basilaris brachyclada*	CA	Plant	BS
Bedstraw, California (San Jacinto)	*Galium californicum primum*	CA	Plant	BS
Bedstraw, El Dorado (San Jacinto)	*Galium californicum sierrae*	CA	Plant	FE
Bedstraw, Hardham's	*Galium hardhamiae*	CA	Plant	BS
Bedstraw, Kingston	*Galium hilendiae kingstonense*	CA, NV	Plant	BS
Bedstraw, Modoc	*Galium glabrescens modocense*	CA	Plant	BS
Bedstraw, Onyx Peak	*Galium angustifolium onycense*	CA	Plant	BS
Bedstraw, San Gabriel	*Galium grande*	CA	Plant	BS
Bedstraw, Scott Mountain	*Galium serpenticum scotticum*	CA, OR	Plant	BS
Bedstraw, Warner Mountains	*Galium serpenticum warnernse*	CA	Plant	BS
Bee, Mojave Gyspsum	*Andrena balsamorhiza*	NV	Insect	BS
Bee, Mojave Poppy	*Perdita meconis*	NV	Insect	BS
Beehive cacus, Santa Cruz	*Coryphantha recurvata*	AZ	Plant	BS
Beeplant, Yellow	*Cleome lutea*	MT	Plant	BS
Beetle, American Burying	*Nicrophorus americanus*	MT, NM, WY	Insect	FE
Beetle, Blind Cave Leiodid	*Glacicavicola bathyscoides*	ID	Insect	BS
Beetle, Bruneau Dunes Tiger	*Cicindela waynei*	ID	Insect	BS
Beetle, Chiricahua Water Scavenger	*Cymbiodyta arizonica*	AZ	Insect	BS
Beetle, Ciervo Aegialian Scarab	*Aegialia concinna*	CA	Insect	BS
Beetle, Columbia River Tiger	*Cicendela columbica*	ID, OR	Insect	BS
Beetle, Coral Pink Sand Dunes	*Cicndela limbata albissima*	UT	Insect	C
Beetle, Devil's Hole Warm Spring Riffle	*Stenelmis calida calida*	NV	Insect	BS
Beetle, Large Aegilian Scarab	*Aegialia magnifica*	NV	Insect	BS
Beetle, Maricopa Tiger	*Cicindela oregona maricopa*	AZ	Insect	BS
Beetle, Moapa Warm Spring Riffle	*Stenelmis moapa*	NV	Insect	BS
Beetle, Roth's Blind Ground	*Pterostichus rothi*	OR	Insect	BS
Beetle, San Joaquin Dune	*Coelus gracilis*	CA	Insect	BS
Beetle, St. Anthony Sand Dunes Tiger	*Cicindela arenicola*	ID	Insect	BS
Beetle, Valley Elderberry Longhorn	*Desmocerus californicus dimorphus*	CA	Insect	FT
Bensoniella, Oregon	*Bensoniella oregana*	OR	Plant	BS
Bentgrass, Henderson's	*Agrostis hendersonii*	OR	Plant	BS
Bentgrass, Hoover's	*Agrostis hooveri*	CA	Plant	BS
Bentgrass, Howell's	*Agrostis howelli*	OR	Plant	BS
Bicscuitroot, Clark's	*Lomatium graveolens alpinum*	NV, UT	Plant	BS
Bicscuitroot, Sanicle (Toiyabe Springparsley	*Cymopterus goodrichii*	NV	Plant	BS
Bird's Beak, Hispid	*Cordylanthus mollis hispidus*	OR	Plant	BS
Bird's Beak, Pallid	*Cordylanthus tenuis pallescens*	CA	Plant	BS

Common Name	Scientific Name	State	Class	Status[1]
Bird's-beak, Point Reyes	*Cordylanthus maritimus palustris*	OR	Plant	BS
Birdbeak, Tecopa	*Cordylanthus tecopensis*	CA, NV	Plant	BS
Biscuitroot, Sanicle (Ripley Biscuitroot)	*Cymopterus ripleyi saniculoides*	CA, NV	Plant	BS
Biscuitroot, Wideleaf	*Lomatium latilobum*	CO, UT	Plant	BS
Bittercress, Constance's	*Cardamine constancei*	ID	Plant	BS
Bittercress, Saddle Mountain	*Cardamine pattersonii*	OR	Plant	BS
Bitterweed, Richardson's	*Hymenoxys richardsonii*	ID	Plant	BS
Blackbird, Brewer's	*Euphagus cyanocephalus*	ID	Bird	W
Blackbird, Tricolored	*Agelaius tricolor*	CA, NV	Bird	BS
Bladderpod, Beautiful	*Lesquerella pulchella*	MT	Plant	BS
Bladderpod, Calder's	*Lesquerella calderi*	AK	Plant	BS
Bladderpod, Dudley Bluffs	*Lesquerella congesta*	CO	Plant	FT
Bladderpod, Fremont	*Lesquerella fremontii*	WY	Plant	BS
Bladderpod, Garnet	*Lesquerella carinata languida*	MT	Plant	BS
Bladderpod, Kodachrome	*Lesquerella tumulosa*	UT	Plant	FE
Bladderpod, Large-fruited	*Lesquerella macrocarpa*	WY	Plant	BS
Bladderpod, Montrose	*Lesquerella vicina*	CO	Plant	BS
Bladderpod, Pagosa	*Lesquerella pruinosa*	CO	Plant	BS
Bladderpod, Piceance	*Lesquerella parviflora*	CO	Plant	BS
Bladderpod, Prostrate	*Lesquerella prostrata*	WY	Plant	BS
Bladderpod, Pryor Mountains	*Lesquerella lesicii*	MT	Plant	BS
Bladderpod, Sidesaddle	*Lesquerella arenosa agrillosa*	WY	Plant	BS
Bladderpod, Western	*Lesquerella multiceps*	WY	Plant	BS
Bladderpod, Whitebluff's	*Lesquerella tuplashensis*	OR	Plant	C
Blazingstar, Ash Meadows	*Mentzelia leucophylla*	NV	Plant	FT
Blazingstar, Bractless	*Mentzelia nuda*	MT	Plant	BS
Blazingstar, Dwarf	*Mentzelia pumila*	MT	Plant	BS
Blazingstar, Golden	*Mentzelia chrysantha*	CO	Plant	BS
Blazingstar, Goodrich's	*Mentzelia goodrichii*	UT	Plant	BS
Blazingstar, Many-stemmed	*Mentzelia multicaulis librina*	UT	Plant	BS
Blazingstar, Parckard's	*Mentzelia packardiae*	NV	Plant	BS
Blazingstar, Shultz'	*Mentzelia shultziorum*	UT	Plant	BS
Blazingstar, Soft	*Mentzelia montana*	MT	Plant	BS
Blazingstar, Tiehm	*Mentzelia tiehmii*	NV	Plant	BS
Blazingstar, United	*Mentzelia congesta*	ID	Plant	W
Blue, Sand Mountain	*Euphilotes palliscens* ssp.*arenamontana*	NV	Insect	BS
Bluebell, Drummond's	*Mertensia drummondii*	AK	Plant	BS
Blue-eyed grass, Hitchcok's	*Sisyrinchium hitchcockii*	OR	Plant	BS
Blue-eyed grass, Mountain	*Sisyrinchium sarmentosum*	OR	Plant	BS
Blue-eyed grass, Pale	*Sisyrinchium pallidum*	CO	Plant	BS
Bluegrass, Alaska	*Poa hartzii alaskana*	AK	Plant	BS
Bluegrass, Loose-flowered	*Poa laxiflora*	OR	Plant	BS
Bluegrass, Ocean-bluff	*Poa unilateralis*	OR	Plant	BS
Bluegrass, Short-leaved	*Poa arnowiae*	MT	Plant	BS
Blue-star, Fugate's	*Amsonia fugatei*	NM	Plant	BS
Blue-star, Jones	*Amsonia jonesii*	CO	Plant	BS
Blue-star, Kearney's	*Amsonia kearneyana*	AZ, CA	Plant	FE
Blue-star, Peebles	*Amsonia peeblesii*	AZ	Plant	BS
Blue-star, Tharps	*Amsonia tharpii*	NM	Plant	BS
Boa, Rosy	*Lichanura trivirgata*	AZ, CA	Reptile	BS

Common Name	Scientific Name	State	Class	Status[1]
Bobolink	*Dolichonyx oryzivorus*	NV	Bird	BS
Bobolink	*Dolichonyx oryzivorus*	OR	Bird	BS
Bog orchid, Alcove	*Platanthera zothecina*	UT	Plant	BS
Bog sedge, Simple	*Kobresia simpliciuscula*	MT	Plant	BS
Bog Thistle, Chorro Creek	*Cirsium fontinale obispoense*	CA	Plant	FE
Bolandra, Oregon	*Bolandra oregana*	OR	Plant	BS
Bolete, Red-pored	*Boletus haematinus*	OR	Fungi	BS
Brant, Black	*Branta bernicla*	AK	Bird	BS
Breadroot, Intermountain	*Pediomelum megalanthum epipsilum*	UT	Plant	BS
Breadroot, Paradox	*Pediomelum aromaticum*	CO, UT	Plant	BS
Brittlebrush, Annual	*Psathyrotes annua*	ID	Plant	BS
Brodiaea, Orcutt's	*Brodiaea orcuttii*	CA	Plant	BS
Brodiaea, Thread-leaved	*Brodiaea filifolia*	CA	Plant	FT
Broom, Round-leaf	*Errazurizia rotundata*	AZ	Plant	BS
Buckwheat, Altered Andesite	*Eriogonum robustrum*	NV	Plant	BS
Buckwheat, Brandegee Wild	*Eriogonum brandegeei*	CO	Plant	BS
Buckwheat, Bull Mountain	*Eriogonum cronquisti*	UT	Plant	BS
Buckwheat, Cache Peak	*Eriogonum kennedyi pinicola*	CA	Plant	BS
Buckwheat, Calcareous	*Eriogonum ochrocephalum calcareum*	ID	Plant	BS
Buckwheat, Clay-loving wild	*Eriogonum pelinophilum*	CO	Plant	FE
Buckwheat, Clokey	*Eriogonum heermannii clokeyii*	NV	Plant	BS
Buckwheat, Colorado Wild	*Eriogonum coloradense*	CO	Plant	BS
Buckwheat, Comb Wash	*Eriogonum clavellatum*	CO	Plant	BS
Buckwheat, Crosby's	*Eriogonum crosbyae*	CA, NV	Plant	BS
Buckwheat, Cushenbury	*Eriogonum ovalifolium vineum*	CA	Plant	FE
Buckwheat, Cusick's	*Eriogonum cusickii*	OR	Plant	BS
Buckwheat, Desert	*Eriogonum desertorum*	ID	Plant	BS
Buckwheat, Duchesne	*Eriogonum viridulum*	CO	Plant	BS
Buckwheat, Ephedra	*Eriogonum ephedroides*	CO	Plant	BS
Buckwheat, Flat-top	*Eriogonum smithii*	MT	Plant	BS
Buckwheat, Forked	*Eriogonum bifurcatum*	CA, NV	Plant	BS
Buckwheat, Frisco	*Eriogonum soredium*	CA	Plant	BS
Buckwheat, Grand	*Eriogonum contortum*	CO	Plant	BS
Buckwheat, Golden	*Eriogonum corymbosum aureum*	NV	Plant	BS
Buckwheat, Gypsum Wild	*Eriogonum gypsophilum*	NM	Plant	FT
Buckwheat, Heerman's Wild	*Eriogonum heermannii occidentale*	NV	Plant	BS
Buckwheat, Ione	*Eriogonum apricum*	CA	Plant	FE
Buckwheat, Klamath Mountain	*Eriogonum hirtellum*	CA	Plant	BS
Buckwheat, Lewis	*Eriogonum lewisii*	NV	Plant	BS
Buckwheat, Matted	*Eriogonum caespitosum*	MT	Plant	BS
Buckwheat, Matted Cowpie (Shockley's Matted Buckwheat)	*Eriogonum shockleyi shockleyi*	ID	Plant	BS
Buckwheat, Mouse	*Eriogonum nudum murinum*	CA	Plant	BS
Buckwheat, Packard's Cowpie	*Eriogonum shockleyi packardiae*	ID	Plant	BS
Buckwheat, Panamint Mtn.	*Eriogonum microthecum panamintense*	CA	Plant	BS
Buckwheat, Prostrate (Austin Buckwheat)	*Eriogonum prociduum*	CA, NV, OR	Plant	BS
Buckwheat, Railroad Canyon	*Eriogonum soliceps*	UT	Plant	BS
Buckwheat, Red Mountain	*Eriogonum kelloggii*	CA	Plant	C
Buckwheat, San Carlos Wild	*Eriogonum capillare*	NM	Plant	BS
Buckwheat, Scarlet	*Eriogonum phoeniceum*	NV	Plant	BS

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Buckwheat, Smooth	*Eriogonum salsuginosum*	MT	Plant	BS
Buckwheat, Snow Mountain	*Eriogonum nervulosum*	CA	Plant	BS
Buckwheat, Steamboat	*Eriogonum ovalifolium williamsiae*	NV	Plant	FE
Buckwheat, Sulphurflower	*Eriogonum umbellatum glaberrimum*	CA, OR	Plant	BS
Buckwheat, Tiehm	*Eriogonum tiehmii*	NV	Plant	BS
Buckwheat, Tremblor	*Eriogonum temblorense*	CA	Plant	BS
Buckwheat, Umtanum Desert	*Eriogonum codium*	OR	Plant	C
Buckwheat, Vishor's	*Eriogonum visheri*	MT	Plant	BS
Buckwheat, Welsh's	*Eriogonum capistratum welshii*	ID	Plant	BS
Buckwheat, Wild Rose Canyon	*Eriogonum eremicola*	CA	Plant	BS
Buckwheat, Wild Single-stemmed	*Eriogonum acaule*	CO	Plant	BS
Buckwheat, Windloving	*Eriogonum anemophilum*	NV, UT	Plant	BS
Buckwheat, Woodside	*Eriogonum tumulosum*	CO	Plant	BS
Buckwheat, Yukon Wild	*Eriogonum flavum aquilinum*	AK	Plant	BS
Buckwheat, Zion	*Eriogonum zionis zionis*	UT	Plant	BS
Bug, Harney Hot Spring Shore	*Micracanthia fennica*	OR	Insect	BS
Bug, Pahranagat Naucorid	*Pelociris shoshone shoshone*	NV	Insect	BS
Bug, Santa Rita Mountains Chlorochroan	*Chlorochroa rita*	AZ	Insect	BS
Bugbane, Tall	*Cimicifuga elata*	OR	Plant	BS
Bug moss, Green	*Buxbaumia viridis*	CA	Plant	BS
Bug-on-a-stick, Leafless	*Buxbaumia aphylla*	OR	Bryophyte	BS
Bug-on-a-stick, Piper's	*Buxbaumia piperi*	CA	Bryophyte	BS
Bullrush, Little (Rolland's)	*Trichophorum pumilum*	CO, ID, MT	Plant	BS
Bullrush, Slender	*Schoenoplectus heterochaetus*	MT	Plant	BS
Bunting, McKay's	*Plectrophenax hyperboreus*	AK	Bird	BS
Burbot	*Lota lota*	ID	Fish	BS
Bush lupine, Mountain Springs	*Lupinus excubitus medius*	CA	Plant	BS
Bush-mallow, Carmel Valley	*Malacothamnus palmeri involucratus*	CA	Plant	BS
Bush-mallow, Indian Valley	*Malacothamnus aboriginum*	CA	Plant	BS
Buttercup, Alaskan Glacier	*Beckwithia glacialis alaskana*	AK	Plant	BS
Buttercup, Autumn	*Ranunculus aestivalis*	UT	Plant	FE
Buttercup, Dalles Mountain	*Ranunculus reconditis*	OR	Plant	BS
Buttercup, Southern Oregon	*Ranunculus austrooreganus*	OR	Plant	BS
Butterfly Plant, Colorado	*Gaura neomexicana coloradensis*	CO, WY	Plant	FT
Butterfly, Baking Powder Flat Blue	*Euphilotes bernadino minuta*	NV	Insect	BS
Butterfly, Carson Valley Silverspot	*Speyeria nokomis carsonensis*	NV	Insect	BS
Butterfly, Desert Viceroy	*Limenitis archippus obsoleta*	NM	Insect	BS
Butterfly, Early Blue	*Euphilotes enoptes primavera*	NV	Insect	BS
Butterfly, Fender's Blue	*Icaricia icarioides fenderi*	OR	Insect	FE
Butterfly, Fused Battoides Blue	*Euphilotes battoides fusimaculata*	NV	Insect	BS
Butterfly, Giulani's Blue	*Eupilotes ancilla giulanii*	NV	Insect	BS
Butterfly, Great Basin Small Blue	*Philotiella speciiosa septentrionalis*	NV	Insect	BS
Butterfly, Grey's Silverspot	*speyeria hesperis greyi*	NV	Insect	BS
Butterfly, Honey Lake Blue	*Euphilotes pallescens calneva*	NV	Insect	BS
Butterfly, Insular Blue	*Plebejus saepiolus insulanus*	OR	Insect	BS
Butterfly, Koret's Checkerspot	*Euphyrdryas editha koreti*	NV	Insect	BS
Butterfly, Mattoni's Blue	*Euphilotes pallescens mattonii*	NV	Insect	BS
Butterfly, Mono Checkerspot	*Euphyrdyas editha monoenisis*	NV	Insect	BS
Butterfly, New Mexico Silverspot	*Speyeria nokomis nitocris*	NM	Insect	BS
Butterfly, Northern Mojave Blue	*Euphilotes mojave virginensis*	NV	Insect	BS

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Butterfly, Oregon Silverspot	*Speyeria zerene hippolyta*	OR	Insect	FT
Butterfly, Quino Checkerspot	*Euphydrayas editha quino*	CA	Insect	FE
Butterfly, Rice's Blue	*Euphilotes pallescens ricei*	NV	Insect	BS
Butterfly, Sand Mountain Blue	*Euphilotes pallescens arenamontana*	NV	Insect	BS
Butterfly, Shield's Blue	*Euphilotes ancilla shieldsi*	NV	Insect	BS
Butterfly, Steptoe Valley Crescentspot	*Phyciodes pascoiensis arenacolor*	NV	Insect	BS
Butterfly, Taylor's Checkerspot	*Euphydrayas editha taylori*	OR	Insect	C
Butterfly, Uncomopahgre Fritillary	*Boloria improba acrocnema*	CO	Insect	FE
Butterweed, Layne's	*Senecio layneae*	CA	Plant	FT
Cabbage, Wild	*Caulanthus major nevadensis*	OR	Plant	BS
Cactus, Acuna	*Echinomastus erectocentrus acunensi*	AZ	Plant	C
Cactus, Bakersfield	*Opuntia treleasei*	CA	Plant	FE
Cactus, Cochise Pincushion	*Coryphantha robbinsorum*	AZ	Plant	FT
Cactus, Cushion	*Coryphantha vivipara*	ID	Plant	BS
Cactus, Knowlton	*Pediocactus knowltonii*	CO, NM	Plant	FE
Cactus, Lee Pincushion	*Coryphantha sneedii leei*	NM	Plant	FT
Cactus, Peebles Navajo	*Pediocactus peeblesianus peeblesian*	AZ	Plant	FE
Cactus, Pima Pineapple	*Coryphantha scheeri robustispina*	AZ	Plant	FE
Cactus, San Rafael	*Pediocactus despainii*	UT	Plant	FE
Cactus, Sneed's Pincushion	*Coryphantha sneedii sneedii*	NM	Plant	FE
Cactus, Villard's Pincushion	*Escobaria villardii*	NM	Plant	BS
Cactus, Winkler	*Pediocactus winkleri*	UT	Plant	FT
Caddisfly, Haddock's Rhyacophilan	*Rhyacophila haddocki*	OR	Insect	BS
Caddisfly, Scott's Apatanian	*Allomyia scotti*	OR	Insect	BS
Calicoflower, Bach's	*Downingia bacigalupii*	ID	Plant	BS
Calicoflower, Harlequin	*Downingia insignis*	ID	Plant	BS
Camas, Howell's	*Camassia howellii*	OR	Plant	BS
Camissonia, Small	*Camissonia parvula*	MT	Plant	BS
Candle, Miner's	*Cryptantha scoparia*	MT	Plant	BS
Candle, Owl Creek Miner's	*Cryptantha subcapitata*	WY	Plant	BS
Candytuft, Pear-shaped	*Smelowskia pyriformis*	AK	Plant	BS
Caribou, Woodland	*Rangifer tarandus caribou*	OR	Mammal	FE
Catchfly, Gentian	*Eustoma exaltatum*	NV	Plant	BS
Catchfly, Jan's (Nachlinger Catchfly)	*Silene nachlingerae*	NV	Plant	BS
Catchfly, Spalding's	*Silene spaldingii*	ID, MT, OR	Plant	FT
Cat's-eye, Creutzfeldt's	*Cryptantha creutzfeldtii*	UT	Plant	BS
Cat's-eye, Fendler's	*Cryptantha fendleri*	MT	Plant	BS
Cat's-eye, Mariposa	*Cryptantha mariposae*	CA	Plant	BS
Cat's-eye, Shacklette's	*Cryptantha shackletteana*	AK	Plant	BS
Cat's-eye, Smooth	*Cryptantha semiglabra*	UT	Plant	BS
Catseye, White River (Welsh Catseye)	*Cryptantha welshii*	NV	Plant	BS
Cauliflower fungus	*Sparassis crispa*	CA	Fungi	BS
Caulostramina, Jaeger's	*Caulostramina jaegeri*	CA	Plant	BS
Ceanothus, Calistoga	*Ceanothus divergens*	CA	Plant	BS
Ceanothus, Lakeside	*Ceanothus cyaneus*	CA	Plant	BS
Ceanothus, Mahala-mat	*Ceanothus prostratus*	ID	Plant	BS
Ceanothus, Rincon Ridge	*Ceanothus confusus*	CA	Plant	BS
Centaury, Spring-loving	*Centaurium namophilum*	CA, NV	Plant	FT
Chaenactis, Shasta	*Chaenactis suffrutescens*	CA	Plant	BS

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Chaffweed	*Anagallis minima*	MT	Plant	BS
Chanterelle, Blue	*Polyozellus multiplex*	CA	Fungi	BS
Char, Angayukaksurak	*Salvelinus anaktuvukensis*	AK	Fish	BS
Char, Kigliak	*Salvelinus alpinus*	AK	Fish	BS
Chat, Yellow-breasted	*Icteria virens*	CO, NV, OR	Bird	BS
Checkerbloom, Hickman's	*Sidalcea hickmanii nov*	OR	Plant	C
Checkerbloom, Parish's	*Sidalcea hickmanii parishii*	CA	Plant	C
Checker-mallow, Butte County	*Sidalcea robusta*	CA	Plant	BS
Checker-mallow, Coast	*Sidalcea oregano eximia*	CA	Plant	BS
Checker-mallow, Dwarf	*Sidalcea malviflora patula*	CA, OR	Plant	BS
Checker-mallow, Henderson's	*Sidalcea hendersonii*	OR	Plant	BS
Checker-mallow, Keck's	*Sidalcea keckii*	CA	Plant	FE
Checker-mallow, Meadow	*Sidalcea campestris*	OR	Plant	BS
Checker-mallow, Nelson's	*Sidalcea nelsoniana*	OR	Plant	FT
Checker-mallow, Wenatchee Mountains	*Sidalcea oregana calva*	OR	Plant	FE
Checkerspot, Spring Mountain Acastus	*Chlosyne acastus robusta*	NV	Insect	BS
Chia, Clay	*Salvia columbariae argillacea*	UT	Plant	BS
Chipmunk, Cliff	*Tamias dorsalis*	ID	Mammal	BS
Chipmunk, Gray-footed	*Tamias canipes*	NM	Mammal	BS
Chipmunk, Organ Mountain Colorado	*Eutamias quadrivittatus australis*	NM	Mammal	BS
Chipmunk, Uinta	*Tamis umbrinus*	ID	Mammal	BS
Cholla, Munz	*Opuntia munzii*	CA	Plant	BS
Cholla, Santa Fe	*Opuntia xviridflora* (*imbricate x whipplei*)	NM	Plant	BS
Chub, Big Smoky Valley Tui	*Gila bicolor*	NV	Fish	BS
Chub, Bonytail	*Gila elegans*	AZ, CA, CO, NV, UT, WY	Fish	FE
Chub, Borax Lake	*Gila boraxobius*	OR	Fish	FE
Chub, Catlow Tui	*Gila bicolor*	OR	Fish	BS
Chub, Cowhead Lake Tui	*Gila bicolor vaccaceps*	CA	Fish	PE
Chub, Fish Creek Springs Tui	*Gila bicolor isolata*	NV	Fish	BS
Chub, Fish Lake Valley Tui	*Gila bicolor*	NV	Fish	BS
Chub, Flathead	*Hybopsis (Platygobio) gracilis*	CO, NM	Fish	BS
Chub, Gila	*Gila intermedia*	AZ, NM	Fish	PE
Chub, Hot Creek Valley Tui	*Gila bicolor*	NV	Fish	BS
Chub, Humpback	*Gila cypha*	AZ, CO, UT, WY	Fish	FE
Chub, Hutton Tui	*Gila bicolor*	OR	Fish	FT
Chub, Independence Valley Tui	*Gila bicolor newarkensis*	NV	Fish	BS
Chub, Least	*Iotichthys phlegethontis*	NM	Fish	BS
Chub, Leatherside	*Gila copei*	ID, UT, WY	Fish	BS
Chub, Mohave Tui	*Gila bicolor mohavensis*	CA	Fish	FE
Chub, Newark Valley Tui	*Gila bicolor newarkensis*	NV	Fish	BS
Chub, Oregon	*Oregonichthys crameri*	OR	Fish	FE
Chub, Oregon Lakes Tui	*Gila bicolor oregonensis*	OR	Fish	BS
Chub, Owens Tui	*Gila bicolor snyderi*	CA	Fish	FE
Chub, Pahranagat Roundtail	*Gila robusta jordani*	NV	Fish	FE
Chub, Railroad Valley Tui	*Gila bicolor*	NV	Fish	BS

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Chub, Rio Grande	*Gila pandora*	CO	Fish	BS
Chub, Roundtail	*Gila robusta*	CO, NM, UT, WY	Fish	BS
Chub, Sheldon Tui	*Gila bicolor eurysoma*	OR	Fish	BS
Chub, Sicklefin	*Macrhybopsis meeki*	MT	Fish	BS
Chub, Sturgeon	*Machrybopsis gelida*	MT, UT	Fish	BS
Chub, Summer Basin Tui	*Gila bicolor*	OR	Fish	BS
Chub, Umpqua	*Oregonichthys kalawatsei*	OR	Fish	BS
Chub, Virgin River	*Gila robusta seminuda*	AZ, NV, UT	Fish	FE
Chuckwalla	*Sauromalus obesus*	AZ	Reptile	BS
Chuckwalla, Glen Canyon	*Sauromalus obesus multiforaminatus*	UT	Reptile	BS
Chuckwalla, Western	*Sauromalus obesus obesus*	UT	Reptile	BS
Cinquefoil, Common	*Potentilla cottamii*	NV, UT	Plant	BS
Cinquefoil, Platte	*Potentilla plattensis*	MT	Plant	BS
Cinquefoil, Soldier Meadow	*Potentilla basaltica*	CA, NV	Plant	C
Cinquefoil, Stipulated	*Potentilla stipularis*	AK	Plant	BS
Cisco, Bonneville	*Prosopium gemmiferum*	ID	Fish	BS
Clarkia, Beaked	*Clarkia rostrata*	CA	Plant	BS
Clarkia, Brandeegee's	*Clarkia biloba bandeegee*	CA	Plant	BS
Clarkia, Brewer's	*Clarkia breweri*	CA	Plant	BS
Clarkia, Caliente	*Clarkia tembloriensis calientensis*	CA	Plant	BS
Clarkia, Mariposa	*Clarkia biloba australis*	CA	Plant	BS
Clarkia, Mildred's	*Clarkia mildrediae mildrediae*	CA	Plant	BS
Clarkia, Mosquin's	*Clarkia mosquinii mosquinii*	CA	Plant	BS
Clarkia, Northern	*Clarkia borealis borealis*	CA	Plant	BS
Clarkia, Shasta	*Clarkia borealis arida*	CA	Plant	BS
Clarkia, Small Southern	*Clarkia australis*	CA	Plant	BS
Clarkia, Springville	*Clarkia springvillensis*	CA	Plant	FT
Clarkia, White-stemmed	*Clarkia gracilis albicaulis*	CA	Plant	BS
Cleomella, Flat-seeded	*Cleomella plocasperma*	ID	Plant	BS
Cliff-rose, Arizona	*Purshia subintegra*	AZ	Plant	FE
Clover, DeDecker's	*Trifolium dedeckerae*	CA	Plant	BS
Clover, Douglas'	*Trifolium douglasii*	OR	Plant	BS
Clover, Frisco	*Trifolium friscanum*	UT	Plant	BS
Clover, Leiberg's	*Trifolium leibergii*	NV, OR	Plant	BS
Clover, Mogollon	*Trifolium longipes neurophyllum*	NM	Plant	BS
Clover, Mountain	*Trifolium andinum*	CO	Plant	BS
Clover, Mountain	*Trifolium andinum podocephalum*	NV	Plant	BS
Clover, Owyhee	*Trifolium owyheense*	ID	Plant	BS
Clover, Plumed	*Trifolium plumosum amplifolium*	ID	Plant	BS
Clover, Santa Cruz	*Trifolium buckwestorium*	CA	Plant	BS
Clover, Thompson's	*Trifolium thompsonii*	OR	Plant	BS
Clubrush, Water	*Schoenoplectus subterminalis*	ID, OR	Plant	BS
Collomia, Barren Valley	*Collomia renacta*	NV, OR	Plant	BS
Collomia, Mount Mazama	*Collomia mazama*	ID	Plant	BS
Collybia, Branched	*Collybia racemosa*	CA	Fungi	BS
Columbine, Golden	*Aquilegia chrysantha rydbergii*	ID	Plant	BS
Columbine, Laramie	*Aquilegia laramiensis*	WY	Plant	BS
Columbine, Lori's	*Aquilegia loriae*	UT	Plant	BS
Columbine, Sitka	*Aquilegia formosa*	MT	Plant	BS
Combleaf, Desert	*Polyctenium fremontii confertum*	OR	Plant	BS

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Combleaf, William's	*Polyctenium williamsiae*	CA, OR	Plant	BS
Condor, California	*Gymnogyps californianus*	AZ, CA, UT	Bird	FE, XE
Contra yerba	*Pediomelum hypogaeum scaposum*	NM	Plant	BS
Coral, Hairy-stemmed	*Clavulina castanopes lignicola*	CA	Fungi	BS
Coral, Strap-shaped	*Clavariadelphus ligula*	CA	Fungi	BS
Coral Mushroom	*Ramaria spinulosa*	OR	Fungi	BS
Coral Mushroom	*Ramaria spinulosa diminutiva*	OR	Fungi	BS
Coral Mushroom, Orange	*Ramaria largentii*	CA	Fungi	BS
Coral Mushroom, Pinkish	*Ramaria amyloidea*	CA	Fungi	BS
Coral Mushroom, Pinkish	*Ramaria cyaneigranosa*	CA	Fungi	BS
Coral Mushroom, Yellow	*Ramaria aurantiisiccescens*	CA	Fungi	BS
Coralroot, Chisos Mountains	*Hexalectris revoluta*	AZ	Plant	BS
Coralroot, Glass Mountain	*Hexalectris nitida*	NM	Plant	BS
Coralroot, Purple-spike	*Hexalectris warnockii*	AZ	Plant	BS
Coreopsis, Mount Hamilton	*Coreopsis hamiltonii*	CA	Plant	BS
Cory cactus, Duncan's	*Escobaria dasyacantha duncanii*	NM	Plant	BS
Corydalis, Case's	*Corydalis caseana hastata*	ID	Plant	BS
Corydalis, Cold-water	*Corydalis aquae-gelidae*	OR	Plant	BS
Cottongrass, Slender	*Eriophorum gracile*	CO	Plant	BS
Coyote-thistle, Oregon	*Eryngium petiolatum*	OR	Plant	BS
Crane, Whooping	*Grus americana*	CO, ID, MT, WY	Bird	FE, XE
Crazyweed, Challis	*Oxytropis besseyi salmonensis*	ID	Plant	BS
Crazyweed, Columbia	*Oxytropis campestris columbiana*	OR	Plant	BS
Crazyweed, Wanapum	*Oxytropis campestris wanapum*	OR	Plant	BS
Cream-scas, Pink	*Castilleja rubicundula rubicundula*	CA	Plant	BS
Cricket, Arizona Giant Sand Treader	*Daihinibaenetes arizonensis*	AZ	Insect	BS
Cricket, Mary's Peak Ice	*Grylloblatta* sp.	OR	Insect	BS
Cricket, Navajo Jerusalem	*Stenopelmatus navajo*	AZ	Insect	BS
Crownscale, San Jacinto Valley	*Atriplex coronata notatior*	CA	Plant	FE
Cryptantha, Gander's	*Cryptantha ganderi*	CA	Plant	BS
Cryptantha, Mound	*Cryptantha compacta*	UT	Plant	BS
Cryptantha, Osterhout	*Cryptantha osterhoutii*	CO	Plant	BS
Cryptantha, Rollins	*Cryptantha rollinsii*	CO	Plant	BS
Cryptantha, Schoolcraft's (School Catseye)	*Cryptantha schoolcraftii*	CA, NV	Plant	BS
Cryptantha, Silky	*Cryptantha sericea*	CA	Plant	W
Cryptantha, Tufted	*Cryptantha caespitosa*	CO, ID	Plant	BS
Cryptantha, Unita Basin	*Cryptantha breviflora*	ID	Plant	BS
Cuckoo, Western Yellow-billed	*Coccyzus americanus occidentalis*	AZ, CA, CO, ID, MT, NM, NV, OR, UT, WY	Bird	C
Cui-ui	*Chasmistes cujus*	NV	Fish	FE
Curlew, Bristle-thighed	*Numenius tahitiensis*	AK	Bird	BS
Curlew, Eskimo	*Numenius borealis*	AK	Bird	FE
Curlew, Long-billed	*Numenius americanus*	CO, MT, NV, UT, WY	Bird	BS
Curlew, Long-billed	*Numenius americanus*	ID	Bird	W
Currant, Moreno San Diego	*Ribes canthariforme*	CA	Plant	BS
Cushenbury, Oxytheca	*Oxytheca parishii goodmaniana*	CA, UT	Plant	FE

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Cutthroat, Bear Lake	*Oncorhynchus clarki utah*	ID	Fish	BS
Cycladenia, Jones	*Cycladenia humilis jonesii*	AZ, UT	Plant	FT
Cymopterus, Desert	*Cymopterus deserticola*	CA	Plant	BS
Cypress, Piute	*Cupressus arizonica nevadensis*	CA	Plant	BS
Cypress, Tecate	*Cupressus forbesii*	CA	Plant	BS
Dace, Amargosa Speckled	*Rhinichthys osculus nevadensis*	CA	Fish	BS
Dace, Amargosa Speckled	*Rhinichthys osculus nevadensis*	NV	Fish	FE
Dace, Big Smoky Valley Speckled	*Rhinichthys osculus lariversi*	NV	Fish	BS
Dace, Clover Valley Speckled	*Rhinichthys osculus oligiporus*	NV	Fish	FE
Dace, Desert	*Eremichthys acros*	NV	Fish	FT
Dace, Foskett Speckled	*Rhinichthys osculus* ssp.	OR	Fish	FT
Dace, Independence Valley Speckled	*Rhinichthys osculus lethoporus*	NV	Fish	FE
Dace, Kendall Warm Springs	*Rhinichthys osculus thermalis*	WY	Fish	FE
Dace, Longfin	*Agosia chrysogaster*	AZ, NM	Fish	BS
Dace, Meadow Valley Wash Speckled	*Rhinichthys osculus* spp.	NV	Fish	BS
Dace, Millicoma	*Rhinichthys cataractae*	OR	Fish	BS
Dace, Moapa	*Moapa coriacea*	NV	Fish	FE
Dace, Moapa Speckled	*Rhinichthys osculus moapae*	NV, OR	Fish	BS
Dace, Monitor Valley Speckled	*Rhinichthys osculus* spp.	NV	Fish	BS
Dace, Northern Redbelly X Finescale	*Phoxinus eos / X Phoxinus neogaeus*	MT	Fish	BS
Dace, Oasis Valley Speckled	*Rhinichthys osculus* spp.	NV	Fish	BS
Dace, Pahranagat Speckled	*Rhinichthys osculus velifer*	NV	Fish	BS
Dace, Pearl	*Margariscus margarita nachtriebi*	MT	Fish	BS
Dace, Relict	*Relictus solitarius*	NV	Fish	BS
Dace, Speckled	*Rhinichthys osculus*	AZ, NM	Fish	BS
Dace, White River Speckled	*Rhinichthys osculus* spp.	NV	Fish	BS
Daisy, Blochman's Leafy	*Erigeron blochmaniae*	CA	Plant	BS
Daisy, Hall's	*Erigeron aequifolius*	CA	Plant	BS
Daisy, Howell's	*Erigeron howellii*	OR	Plant	BS
Daisy, Kachina	*Erigeron kachinensis*	CO, UT	Plant	BS
Daisy, Kern River	*Erigeron multiceps*	CA	Plant	BS
Daisy, Maguire	*Erigeron maguirei*	UT	Plant	FT
Daisy, Oregon	*Erigeron oreganus*	OR	Plant	BS
Daisy, Panamint	*Enceliopsis covillei*	CA	Plant	BS
Daisy, Parish's	*Erigeron parishii*	CA	Plant	FT
Daisy, Willamette	*Erigeron decumbens decumbens*	OR	Plant	FE
Dalea, Jones'	*Psorothamnus polydenius jonesii*	UT	Plant	BS
Dalea, Ornate	*Dalea ornata*	CA	Plant	BS
Dandelion, Desert	*Malacothrix torreyi*	MT	Plant	BS
Dandelion, Rocky Mountain	*Taraxacum eriophorum*	MT	Plant	BS
Darter, Arkansas	*Etheostoma cragini*	CO	Fish	C
Darter, Iowa	*Etheostoma exile*	CO	Fish	BS
Darter, Orangethroat	*Etheostoma spectabile*	MT	Fish	BS
Deer, Columbia White-tailed	*Odocoileus virginianus leucurus*	OR (Douglas County)	Mammal	BS
Deer, Columbia White-tailed	*Odocoileus virginianus leucurus*	OR (Clatsop, Columbia, Multnomah counties)	Mammal	FE
Desertgrass, King's	*Blepharidachne kingii*	ID	Plant	BS

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Desert-mallow, Rusby's	*Sphaeralcea rusbyi eremicola*	CA	Plant	BS
Desert-parsley, Adobe	*Lomatium roseanum*	CA, OR	Plant	BS
Desert-parsley, Bradshaw's	*Lomatium bradshawii*	OR	Plant	FE
Desert-parsley, Colorado	*Lomatium concinnum*	CO	Plant	BS
Desert-parsley, Cook's	*Lomatium cookii*	OR	Plant	FE
Desert-parsley, Hoover's	*Lomatium tuberosum*	OR	Plant	BS
Desert-parsley, Nuttall's	*Lomatium nuttallii*	MT	Plant	BS
Desert-parsley, Packard's	*Lomatium packardiae*	ID	Plant	BS
Desert-parsley, Rollins'	*Lomatium rollinsii*	OR	Plant	BS
Desert-parsley, Salmon-flower	*Lomatium salmoniflorum*	ID	Plant	BS
Desert-parsley, Taper-tip	*Lomatium attenuatum*	MT	Plant	BS
Dickcissel	*Spiza americana*	MT, UT	Bird	BS
Disc, Cockerell's Striate	*Discus shemeki cockerelli*	AZ, UT	Snail	BS
Disc, Marbled	*Discus marmorensis*	ID	Snail	BS
Dodder, Sepal-tooth	*Cuscuta denticulata*	ID	Plant	BS
Dogweed, Wright's	*Adenophyllum wrightii*	NM	Plant	BS
Donkey-ears	*Otidea onotica*	CA	Fungi	BS
Doublet (Dimeresia)	*Dimeresia howellii*	ID	Plant	BS
Dovekie	*Alle alle*	AK	Bird	BS
Draba, Bodie Hills	*Cusickiella quadricostata*	CA, NV	Plant	BS
Draba, Douglas'	*Cusickiella douglasii*	OR	Plant	BS
Draba, Globe-fruited	*Draba globosa*	ID, MT	Plant	BS
Draba, Mount Eddy	*Draba carnosula*	CA	Plant	BS
Draba, Small Petaled Alpine	*Draba alpina*	AK	Plant	BS
Draba, Wind River	*Draba ventosa*	MT	Plant	BS
Dropseed, Tall	*Sporobolus compositus comositus*	ID	Plant	BS
Duck, Canvasback	*Aythya valisineria*	MT	Bird	BS
Duck, Fulvous Whistling	*Dendrocygna bicolor*	AZ	Bird	BS
Duck, Harlequin	*Histrionicus histrionicus*	AK, ID, MT, WY	Bird	BS
Duck, Long-tailed	*Clangula hyemalis*	AK	Bird	BS
Dudleya, Many Stemmed	*Dudleya multicaulis*	CA	Plant	BS
Dudleya, San Luis Obispo Serpentine	*Dudleya abramsii bettinae*	CA	Plant	BS
Dudleya, Variegated	*Dudleya variegata*	CA	Plant	BS
Eagle, Bald	*Haliaeetus leucocephalus*	AK	Bird	BS
Eagle, Bald	*Haliaeetus leucocephalus*	AZ, CA, CO, ID, MT, NM, NV, OR, UT	Bird	FT
Eagle, Golden	*Aquila chrysaetos*	NV, UT, WY	Bird	BS
Earthworm, Oregon Giant	*Driloleirus (Megascolides) macelfreshi*	OR	Annelid	BS
Easter-daisy, Cedar Mountain	*Townsendia microcephala*	WY	Plant	BS
Easter-daisy, Strigose	*Townsendia strigosa*	CO	Plant	BS
Eatonella, White	*Eatonella nivea*	ID, OR	Plant	BS
Eggvetch, Lavin	*Astragalus oophorus lavinii*	NV	Plant	BS
Eggvetch-long Calyx (Pink Eggvetch-long)	*Astragalus oophorus lonchocalyx*	NV, UT	Plant	BS
Eider, King	*Somateria spectabilis*	AK	Bird	BS
Eider, Spectacled	*Somateria fischeri*	AK	Bird	FT
Eider, Steller's	*Polystricta stelleri*	AK	Bird	FT
Elkweed, Pahute	*Frasera albicaulis modocensis*	NV	Plant	BS
Entoloma, Indigo	*Entoloma nitidum*	CA	Fungi	BS

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Estes' artemisia	*Artemisia ludoviviana estesii*	OR	Plant	BS
Evening-primrose, Baird's	*Camissonia bairdii*	UT	Plant	BS
Evening-primrose, Cane Spring	*Camissonia megalantha*	NV	Plant	BS
Evening-primrose, Dwarf	*Camissonia pygmaea*	OR	Plant	BS
Evening-primrose, Hardham's	*Camissonia hardhamiae*	CA	Plant	BS
Evening-primrose, Murdock's	*Oenothera murdocki*	UT	Plant	BS
Evening-primrose, Narrowleaf	*Oenothera acutissima*	CO	Plant	BS
Evening-primrose, Obscure	*Camissonia andina*	MT	Plant	BS
Evening-primrose, Organ Mountain	*Oenothera organensis*	NM	Plant	BS
Evening-primrose, Palmer's	*Camissonia palmeri*	ID	Plant	BS
Evening-primrose, San Benito	*Camissonia benitensis*	CA	Plant	FT
Evening-primrose, Slender	*Camissonia exilis*	AZ	Plant	BS
Evening-primrose, St. Anthony	*Oenothera psammophila*	ID	Plant	BS
Evening-primrose, Winged-seed	*Camissonia pterosperma*	ID	Plant	BS
Evening-primrose, Wolf's	*Oenothera wolfii*	OR	Plant	FE, XE
Fairy-fan	*Spathularia flavida*	CA	Fungi	BS
Fairy Shrimp, Conservancy	*Branchinecta conservatio*	CA	Crustacean	FE
Fairy Shrimp, Longhorn	*Branchinecta longiantenna*	CA	Crustacean	FE
Fairy Shrimp, Vernal Pool	*Branchinecta lynchi*	CA, OR	Crustacean	FT
Fairypoppy, White	*Meconella oregana*	OR	Plant	BS
Falcon, American Peregrine	*Falco peregrinus anatum*	AK, ID, MT, NM, NV, OR, UT, WY	Bird	BS
Falcon, Arctic Peregrine	*Falco peregrinus tundrius*	AK, NM, OR	Bird	BS
Falcon, Northern Aplomado	*Falco femoralis septentrionalis*	AZ, NM	Bird	FE
Falcon, Prairie	*Falco mexicanus*	ID, NV	Bird	BS
False Goldeneye, Tropical	*Heliomeris soliceps*	CA	Plant	BS
False Truffle, Yellow	*Leucogaster citrinus*	CA	Fungi	BS
Fawn-lily, Howell's	*Erythronium howellii*	OR	Plant	BS
Fawn-lily, Scott Mountain	*Erythronium citrinum roderickii*	CA	Plant	BS
Fawn-lily, Tuolumne	*Erythronium tuolumnense*	CA	Plant	BS
Feathergrass, Porter	*Ptilagrostis porteri*	CO	Plant	BS
Felwort, Marsh	*Lomatogonium rotatum*	ID, MT	Plant	BS
Fen Mustard, Alpine	*Eutrema penlandii*	CO	Plant	FT
Fern, Deer	*Blechnum spicant*	ID, NM	Plant	BS
Fern, Goldenback	*Pentagramma triangularis triangular*	ID	Plant	BS
Ferret, Black-footed	*Mustela nigripes*	AZ, CO, MT, NM, UT, WY	Mammal	FE, XE
Feverfew, Ligulate	*Parthenium ligulatum*	CO	Plant	BS
Fiddleleaf, Matted	*Nama densum parviflorum*	CO	Plant	BS
Fiddleneck, Bent-flowered	*Amsinkia lunaris*	CA	Plant	BS
Fieldslug, Evening	*Deroceras hesperium*	OR	Snail	BS
Figwort, Organ Mountain	*Scrophularia laevis*	NM	Plant	BS
Finch, Black Rosy	*Leucosticte atrata*	NV	Bird	BS
Finch, Cassin's	*Carpodacus cassinii*	ID	Bird	W
Fireweed, Oregon	*Epilobium oreganum*	CA, OR	Plant	BS
Fisher	*Martes pennanti*	ID, OR	Mammal	BS
Fisher, Pacific	*Martes pennanti pacifica*	CA, OR	Mammal	BS
Fishhook Cactus, Blaine's	*Sclerocactus blainei*	NV	Plant	BS
Fishhook Cactus, Gramagrass	*Sclerocactus papyracanthus*	NM	Plant	BS
Fishhook Cactus, Mesa Verde	*Sclerocactus mesae-verdae*	CO, NM	Plant	FT

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Fishhook Cactus, Short-spined	*Sclerocactus brevispinus*	UT	Plant	BS
Fishhook Cactus, Wright's	*Sclerocactus wrightiae*	UT	Plant	FE
Flameflower, Cedar Mountain	*Talinum thompsonii*	UT	Plant	BS
Flameflower, Pinos Altos	*Talinum humile*	NM	Plant	BS
Flannelbush, California	*Fremontodendron californicum*	AZ, CA	Plant	BS
Flannelbush, Mexican	*Fremontodendron mexicanum*	CA	Plant	FE
Flannelbush, Pine Hill	*Ceanothus roderickii*	CA	Plant	FE
Flannelbush, Pine Hill	*Fremontodendron californicum decumbens*	CA	Plant	FE
Flannelbush, Pine Hill	*Fremontodendron californicum sierra*	CA	Plant	FE
Flatsedge, Schweinitz'	*Cyperus schweinitzii*	MT	Plant	BS
Flatworm	*Kenkia rhynchida*	OR	Annelid	BS
Flax, Brewer's Dwarf	*Hesperolinon breweri*	CA	Plant	BS
Flax, Drymaria-like Western	*Hesperolinon drymarioides*	CA	Plant	BS
Flax, Glandular Western	*Hesperolinon adenophyllum*	CA	Plant	BS
Flax, Napa Western	*Hesperolinon serpentinum*	CA	Plant	BS
Flax, Tehama County Western	*Hesperolinon tehamense*	CA	Plant	BS
Fleabane, Acoma	*Erigeron acomanus*	NM	Plant	BS
Fleabane, Basalt	*Erigeron basalticus*	OR	Plant	C
Fleabane, Bisti	*Erigeron bistiensis*	NM	Plant	BS
Fleabane, Broad	*Erigeron latus*	ID, NV	Plant	BS
Fleabane, Buff	*Erigeron ochroleucus ochroleucus*	MT	Plant	BS
Fleabane, Desert Yellow	*Erigeron linearis*	MT	Plant	BS
Fleabane, Fish Creek	*Erigeron piscaticus*	AZ	Plant	BS
Fleabane, Idaho	*Erigeron asperugineus*	MT	Plant	BS
Fleabane, Indian Valley	*Erigeron untermannii*	UT	Plant	BS
Fleabane, Lemmon	*Erigeron lemmonii*	AZ	Plant	C
Fleabane, Muir's	*Erigeron muirii*	AK	Plant	BS
Fleabane, Sheep	*Erigeron ovinus*	NV	Plant	BS
Fleabane, Sivinski's	*Erigeron sivinskii*	NM	Plant	BS
Fleabane, Zuni	*Erigeron rhizomatus*	NM	Plant	FT
Floater, California	*Anodonta californiensis*	ID, NV	Mollusk	BS
Flycatcher, Cordilleran	*Empidonax occidentalis*	ID	Bird	W
Flycatcher, Gray	*Empidonax wrightii*	CA	Bird	BS
Flycatcher, Hammond's	*Empidonax hammondii*	ID	Bird	BS
Flycatcher, Olive-sided	*Contopus borealis*	AK, ID, NM, OR, WY	Bird	BS
Flycatcher, Southwestern Willow	*Empidonax traillii extimus*	AZ, CA, CO, NM, NV, UT	Bird	FE
Flycatcher, Willow	*Empidonax traillii*	ID	Bird	BS
Fog-lichen, Powdery	*Vermilacina cephalota*	CA	Plant	BS
Four-o'clock, McFarlane's	*Mirabilis macfarlanei*	ID, OR	Plant	FT
Four-tooth Moss, Bent-kneed	*Tetraphis geniculata*	CA	Plant	BS
Fox, Kit	*Vulpes velox macrotis*	CA, ID	Mammal	BS
Fox, San Joaquin Kit	*Vulpes macrotis mutica*	CA	Mammal	FE
Fox, Swift	*Vulpes velox*	MT, WY	Mammal	BS
Fragrant Kalmiopsis	*Kalmiopsis fragrans*	OR (Douglas County)	Plant	BS
Fritillaria, Gertners	*Fritillaria gentneri*	OR	Plant	FE
Fritillary, Ojai	*Fritillaria ojaiensis*	CA	Plant	BS
Fritillary, Nokomis	*Speyeria nokomis nokomis*	CO, UT	Insect	BS

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Fritillary, San Benito	*Fritillaria viridea*	CA	Plant	BS
Fritillary, Talus	*Fritillaria falcata*	CA	Plant	BS
Frog, California Red-legged	*Rana aurora draytonii*	CA	Amphibian	FT
Frog, Chiricahua Leopard	*Rana chiricahuensis*	AZ, NM	Amphibian	FT
Frog, Columbia Spotted	*Rana luteiventris*	MT, OR, UT, WY	Amphibian	C
Frog, Columbia Spotted (Great Basin Population)	*Rana luteiventris*	ID, NV, OR	Amphibian	C
Frog, Foothill Yellow-legged	*Rana boyleii*	CA	Amphibian	BS
Frog, Northern Cricket	*Acris crepitans*	CA, NM, UT	Amphibian	BS
Frog, Northern Leopard	*Rana pipiens*	CO, ID, OR, WY	Amphibian	BS
Frog, Oregon Spotted	*Rana pretiosa*	OR, WY	Amphibian	C
Frog, Plain's Leopard	*Rana blairi*	CO	Amphibian	BS
Frog, Relict Leopard	*Rana onca*	NV	Amphibian	C
Frog, San Sebastian Leopard	*Rana yavapaiensis*	CA, NM, UT	Amphibian	BS
Frog Stubble	*Calicium viride*	CA	Plant	
Frog, Tailed	*Ascaphus truei*	MT	Amphibian	BS
Frog, Wood	*Rana sylvatica*	MT	Amphibian	BS
Frog, Wood	*Rana sylvatica*	ID	Amphibian	W
Fuzzwort, Pacific	*Ptilidium californicum*	MT	Plant	BS
Gambusia, Pecos	*Gambusia nobilis*	NM	Fish	FE
Gar, Shortnose	*Lepisosteus platostomus*	MT	Fish	BS
Gecko, Utah Banded	*Coleonyx variegates utahensis*	UT	Reptile	BS
Gentian, Bristly	*Gentiana plurisetosa*	OR	Plant	BS
Gentian, Mendocino	*Gentiana setigera*	OR	Plant	BS
Gentian, Tufted Green	*Frasera paniculata*	CO	Plant	BS
Gentian, Utah	*Gentianella tortuosa*	CO	Plant	BS
Gila Monster	*Heloderma suspectum*	CA, UT	Reptile	BS
Gila Monster, Banded	*Heloderma suspectum cinctum*	AZ, NV, UT	Reptile	BS
Gilia, Aztec	*Gilia formosa*	NM	Plant	BS
Gilia, Ballhead	*Ipomopsis congesta crebriolia*	MT	Plant	BS
Gilia, Dark-eyed; Seaside	*Gilia millefoliata*	CA, OR	Plant	BS
Gilia, Hollyleaf	*Gilia latifolia imperialis*	UT	Plant	BS
Gilia, Little San Bernardino Mountain	*Gilia maculata*	CA	Plant	BS
Gilia, Monterey	*Gilia tenuiflora arenaria*	CA	Plant	FE
Gilia, Mussentuchit	*Gilia tenuis*	UT	Plant	BS
Gilia, Narrowstem	*Gilia stenothyrsa*	CO	Plant	BS
Gilia, Pagosa Trumpet	*Ipomopsis polyantha polyantha*	CO	Plant	BS
Gilia, Rabbit Valley (Wonderland Gilia)	*Gilia caespitosa*	UT	Plant	C
Gilia, Spreading	*Ipomopsis polycladon*	ID	Plant	BS
Gilia, Weber's Scarlet	*Ipomopsis aggregate weberi*	WY	Plant	BS
Glasswort, Red	*Salicornia rubra*	ID	Plant	BS
Globeberry, Texas	*Ibervillea tenuisecta*	AZ	Plant	BS
Globeberry, Tumamoc	*Tumamoca macdougalii*	AZ	Plant	BS
Globemallow, Baker's	*Iliamna bakeri*	CA, OR	Plant	BS
Globemallow, Gooseberry-leaf	*Sphaeralcea grossularifolia fumariensis*	UT	Plant	BS
Globemallow, Jane's	*Sphaeralcea janeae*	UT	Plant	BS
Globemallow, Psoralia	*Sphaeralcea psoraloides*	UT	Plant	BS

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Globemallow, Railroad Valley	*Sphaeralcea caespitosa williamsiae*	NV, UT	Plant	BS
Globemallow, White-stemmed	*Sphaeralcea munroana*	MT	Plant	BS
Glossopetalon, Pungent	*Glossopetalon pungens*	CA, NV	Plant	BS
Gnatcatcher, Coastal California	*Polioptila californica californica*	CA	Bird	FT
Goat's foot, Greening	*Albatrellus ellisii*	CA	Plant	BS
Godwit, Black-tailed	*Limosa limosa*	AK	Bird	BS
Godwit, Marbled	*Limosa fedoa*	AK	Bird	BS
Golden-aster, Huachuca	*Heterotheca rutteri*	AZ	Plant	BS
Golden-aster, Shevock's Hairy	*Heterotheca shevockii*	CA	Plant	BS
Goldenbush, Eastwood's	*Ericameria fasciculata*	CA	Plant	BS
Goldenbush, Greenwood's	*Ericameria lignumviridis*	UT	Plant	BS
Goldenbush, Pine Valley	*Ericameria crispus*	UT	Plant	BS
Goldenbush, Zion	*Ericameria zionis*	UT	Plant	BS
Golden-clover, Butte County	*Trifolium jokerstii*	CA	Plant	BS
Goldeneye, Barrow's	*Bucephala islandica*	CO, ID	Bird	BS
Goldeneye, Showy	*Heliomeris multiflora multiflora*	MT	Plant	BS
Goldenrod, Few-flowered	*Solidego velutina*	MT	Plant	BS
Goldenstar, San Diego	*Muilla clevelandii*	CA	Plant	BS
Goldenweed, Bugleg	*Pyrrocoma insecticruris*	ID	Plant	BS
Goldenweed, Howell's One-flowered	*Pyrrocoma uniflorus howellii*	ID	Plant	W
Goldenweed, Large-flowered	*Pyrrocoma carthamoides subsquarrosa*	MT	Plant	BS
Goldenweed, Palouse	*Pyrrocoma liatriformis*	ID, OR	Plant	BS
Goldenweed, Snake River	*Pyrrocoma radiatus*	ID	Plant	BS
Goldfields, Contra Costa	*Lasthenia conjugens*	CA	Plant	FE
Goldfields, Coulter's	*Lasthenia glabrata coulteri*	CA	Plant	BS
Goldfields, Large-flowered	*Lasthenia macrantha* ssp. *prisca*	OR	Plant	BS
Goldthread, Three-leaf	*Coptis trifolia*	OR	Plant	BS
Goose, Aleutian Canada	*Branta canadensis leucopareia*	AK, CA, OR	Bird	DM
Goose, Dusky Canada	*Branta canadensis occidentalis*	AK	Bird	BS
Goose, Tule White-fronted	*Anser albifrons gambelli*	AK	Bird	BS
Gooseberry, Sequoia	*Ribes tularense*	CA	Plant	BS
Goosefoot, Sandhill	*Chenopodium cycloides*	NM	Plant	BS
Gopher, Desert Pocket	*Geomys bursarius tularosae*	NM	Mammal	BS
Gopher, Fish Spring Pocket	*Thomomys bottae abstrusus*	NV	Mammal	BS
Gopher, Guadalupe Pocket	*Thomomys bottae guadalupensis*	NM	Mammal	BS
Gopher, Idaho Pocket	*Thomomys idahoensis*	WY	Mammal	BS
Gopher, San Antonio Pocket	*Thomomys bottae curtatus*	NV	Mammal	BS
Gopher, Southern Pocket	*Thomomys umbrinus emotus*	NM	Mammal	BS
Gopher, Wyoming Pocket	*Thomomys clusius*	WY	Mammal	BS
Goshawk, Northern	*Accipiter gentilis*	CO, ID, MT, NM, NV, OR, UT, WY	Bird	BS
Goshawk, Northern (Queen Charlotte)	*Accipiter gentilis laingi*	AK	Bird	BS
Gramma, Blue	*Bouteloua gracilis*	ID	Plant	BS
Grass Bug, American Acetropis	*Acetropis americana*	OR	Insect	BS
Grass, California Orcutt	*Orcuttia californica*	CA	Plant	FE
Grass, Hairy Orcutt	*Orcuttia pilosa*	CA	Plant	FE
Grass, San Joaquin Valley Orcutt	*Orcuttia inaequalis*	CA	Plant	FT
Grass, Semaphore	*Pleuropogon sabinei*	AK	Plant	BS
Grass, Sessile-leaved Scurvy	*Cochlearia sessilifolia*	AK	Plant	BS

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Grass, Slender Orcutt	*Orcuttia tenuis*	CA	Plant	FT
Grasshopper, Idaho Pointheaded	*Acrolophitus punchellus*	ID	Insect	BS
Grayling, Arctic	*Thymallus arcticus*	MT	Fish	C
Grebe, Red-necked	*Podiceps grisegena*	OR	Bird	BS
Green-molly	*Kochia americana*	MT	Plant	BS
Greenbriar, English Peak	*Smilax jamesii*	CA	Plant	BS
Greenthread, Green River	*Thelesperma caespitosum*	UT, WY	Plant	BS
Greenthread, Uinta	*Thelesperma pubescens*	UT, WY	Plant	BS
Grosbeak, Blue	*Guiraca caerulea*	UT	Bird	BS
Grounddaisy, Charleston	*Townsendia jonesii tumulosa*	NV	Plant	BS
Groundsel, Spellenberg's	*Packera spellenbergii*	NM	Plant	BS
Grouse, Blue	*Dendragapus obsurus*	ID	Bird	W
Grouse, Columbian Sharp-tailed	*Tympanuchus phasianellus columbianus*	CA, CO, ID, MT, NV, UT, WY	Bird	BS
Grouse, Sharp-tailed	*Tympanuchus phasianellus*	UT	Bird	BS
Guillemot, Black	*Cepphus grylle*	AK	Bird	BS
Gumplant, Ash Meadows	*Grindelia fraxino-pratensis*	CA, NV	Plant	FT
Gumweed, Howell's	*Grindelia howellii*	ID	Plant	BS
Gymnopilus, Blue-green	*Gymnopilus punctifolius*	CA	Plant	BS
Harebell, Castle Crags	*Campanula shetleri*	CA	Plant	BS
Harebell, Sharsmith's	*Campanula sharsmithiae*	CA	Plant	BS
Harmonia, Hall's	*Harmonia hallii*	CA	Plant	BS
Harmonia, Nile's	*Harmonia doris-nilesiae*	CA	Plant	BS
Harmonia, Stebbin's	*Harmonia stebbininsii*	CA	Plant	BS
Harrier, Northern	*Circus cyaneus*	ID	Bird	BS
Hawk, Ferruginous	*Buteo regalis*	CO, ID, MT, NM, NV, OR, UT, WY	Bird	BS
Hawk, Northern Gray	*Buteo nitidus maximus*	AZ, ID, MT, NM, WY	Bird	BS
Hawk, Swainson's	*Buteo swainsoni*	ID	Bird	W
Hawk, Swainson's	*Buteo swainsoni*	ID, MT, NV, UT	Bird	BS
Hawksbeard, Idaho	*Crepis bakeri idahoensis*	ID	Plant	BS
Hazardia, Orcutt's	*Hazardia orcuttii*	CA	Plant	BS
Hedgehog, Violet	*Sacodon fuscoindicus*	CA	Fungi	BS
Hedgehog cactus, Arizona	*Echinocereus triglochidiatus arizonicus*	AZ	Plant	FE
Hedgehog cactus, Fickeisen's	*Pediocactus peeblesianus fickeiseni*	AZ	Plant	C
Hedgehog cactus, Howe's	*Echinocereus engelmannii howei*	CA	Plant	BS
Hedgehog cactus, Kuenzler's	*Echinocereus fendleri kuenzleri*	NM	Plant	FE
Hedgehog cactus, Simpson's	*Escobaria simpsonii robustior*	ID	Plant	BS
Hesperian (Snail), Sister's	*Hochbergellus hirsutus*	OR	Snail	BS
Hesperian, Bald	*Vespericola* sp.	OR	Snail	BS
Hookless cactus, Uinta Basin	*Sclerocactus glaucus*	CO, UT	Plant	FT
Hopsage, Spiny	*Gravia spinosa*	MT	Plant	BS
Horkelia, Henderson's	*Horkelia hendersonii*	CA	Plant	BS
Horkelia, Parry's	*Horkelia parryi*	CA	Plant	BS
Horkelia, Shaggy	*Horkelia congesta congesta*	OR	Plant	BS
Horse-mint, Cusick's	*Agastache cusickii*	MT	Plant	BS
Howell's Spectacular Thelypody	*Thelypodium howellii spectabilis*	OR	Plant	FT

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Howell's Spineflower	*Chorizanthe howellii*	CA	Plant	FE
Howellia, Water	*Howellia aquatilis*	CA, ID, MT	Plant	FT
Hutchinsia, Prostrate	*Hutchinsia procumbens*	MT	Plant	BS
Hummingbird, Calliope	*Stellula calliope*	ID	Bird	BS
Ibis, White-faced	*Plegadis chihi*	AZ, CO, ID, NM, WY	Bird	BS
Iguana, Desert	*Dipsosaurus dorsalis*	UT	Reptile	BS
Indian Potato, Taper-root	*Orogenia fusiformis*	MT	Plant	BS
Indigo Bush, Gentry	*Dalea tentaculoides*	AZ	Plant	BS
Iris, Munz'	*Iris munzii*	CA	Plant	BS
Iris, Rocky Mountain	*Iris pariensis*	UT	Plant	BS
Isopod, Socorro	*Exosphaeroma thermophilus*	NM	Crustacean	FE
Ivesia, Alkali	*Ivesia kingii kingii*	CA	Plant	BS
Ivesia, Ash Creek	*Ivesia paniculata*	CA	Plant	BS
Ivesia, Ash Meadows	*Ivesia kingii eremica*	NV	Plant	FT
Ivesia, Castle Crags	*Ivesia longibracteata*	CA	Plant	BS
Ivesia, Grimy	*Ivesia rhypara rhypara*	CA, NV	Plant	BS
Ivesia, Jaeger's	*Ivesia jaegeri*	CA, NV	Plant	BS
Ivesia, Kingston Mountains	*Ivesia patellifera*	CA	Plant	BS
Ivesia, Pickering's	*Ivesia pickeringii*	CA	Plant	BS
Ivesia, Pine Nut Mountains	*Ivesia pityocharis*	NV	Plant	BS
Ivesia, Plumas	*Ivesia sericoleuca*	CA	Plant	BS
Ivesia, Shelly's	*Ivesia rhypara shellyi*	OR	Plant	BS
Ivesia, Sierra Valley	*Ivesia aperta aperta*	CA, NV	Plant	BS
Ivesia, Webber's	*Ivesia webberi*	CA	Plant	BS
Jaguar	*Panthera onca*	AZ, NM	Mammal	FE
Jay, Pinyon	*Gymnorhinus cyanocephalus*	ID, NV	Bird	BS
Jewel-flower, California	*Caulanthus californicus*	CA	Plant	FE
Jewel-flower, Dorr's Cabin	*Streptanthus morrisonii hirtiflorus*	CA	Plant	BS
Jewel-flower, Freed's	*Streptanthus brachiatus hoffmanii*	CA	Plant	BS
Jewel-flower, Hoffmann's	*Streptanthus glandulosus hoffmanii*	CA	Plant	BS
Jewel-flower, Kruckeberg's	*Streptanthus morrisonii kruckebergi*	CA	Plant	BS
Jewel-flower, Lemmon's	*Caulanthus coulteri*	CA	Plant	BS
Jewel-flower, Masonic Mountain	*Streptanthus oliganthus*	CA, NV	Plant	BS
Jewel-flower, Metcalf Canyon	*Streptanthus albidus albidus*	CA	Plant	FE
Jewel-flower, Morrison's	*Streptanthus morrisonii morrisonii*	CA	Plant	BS
Jewel-flower, Mount Hamilton	*Streptanthus callistus*	CA	Plant	BS
Jewel-flower, Piute Mountains	*Streptanthus cordatus piutensis*	CA	Plant	BS
Jewel-flower, Socrates Mine	*Streptanthus brachiatus brachiatus*	CA	Plant	BS
Jewel-flower, Three Peaks	*Streptanthus morrisonii elatus*	CA	Plant	BS
Juga (Snail), Barren	*Juga hemphilli hemphilli*	OR	Snail	BS
Juga (Snail), Bulb	*Juga bulbosa*	OR	Snail	BS
Juga (Snail), Dalles	*Juga hemphilli dallesensis*	OR	Snail	BS
Juga (Snail), Opal Springs	*Juga* sp.	OR	Snail	BS
Juga, Purple-lipped (Deschutes)	*Juga hemphilli maupinensis*	OR	Snail	BS
Jumping-slug, Malone	*Hemphillia malone*	OR	Snail	BS
Kentrophyta, Bastard	*Astragalus tegetarioides*	OR	Plant	BS
Kingsnake, California Mountain	*Lampropeltis zonata*	CA	Reptile	BS
Kingsnake, Common	*Lampropeltis getula*	CO	Reptile	BS
Kingsnake, Sonoran Mountain	*Lampropelitis pyromelana*	NV	Reptile	BS
Kingsnake, St. Helena Mountain	*Lampropeltis zonata zonata*	CA	Reptile	BS

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Kingsnake, Utah Mountain	*Lampropeltis pyromelana infralabialis*	UT	Reptile	BS
Knot, Red	*Calidris canutus*	AK	Bird	BS
Knotweed, Modoc County	*Polygonum polygaloides esotericum*	CA	Plant	BS
Lacewing, Cheese-weed Moth	*Oliarces clara*	AZ	Insect	BS
Ladies'-tresses, Canelo Hills	*Spiranthes delitescens*	AZ	Plant	FE
Ladies'-tresses, Ute	*Spiranthes diluvialis*	CO, ID, MT	Plant	FT
Ladies'-tresses, Western	*Spiranthes porrifolia*	ID	Plant	BS
Lady's-slipper, Clustered	*Cypripedium fasciculatum*	CA, OR	Plant	BS
Lady's-slipper, Mountain	*Cypripedium montanum*	CA	Plant	BS
Lady's-slipper, Small Yellow	*Cypripedium parviflorum*	ID	Plant	BS
Lady's-slipper, Yellow	*Cypripedium alpinum*	OR	Plant	BS
Lamprey, Goose Lake	*Lampetra tridentata* ssp	CA, OR	Fish	BS
Lamprey, Pacific	*Lampetra tridentata*	ID	Fish	BS
Lamprey, Western Brook	*Lampetra richardsoni*	AK	Fish	BS
Lanx, Rotund	*Lanx subrotundata*	OR	Snail	BS
Lanx, Scale	*Lanx klamathensis*	OR	Snail	BS
Lanx, Shortface	*Fisherola nuttalli*	ID	Snail	BS
Laphamia, Inyo	*Perityle inyoensis*	CO	Plant	BS
Lark, Streaked Horned	*Eremophila alpestris strigata*	OR	Bird	C
Larkspur, Dune	*Delphinium parryi blochamaniae*	CA	Plant	BS
Larkspur, Kern County	*Delphinium purpusii*	CA	Plant	BS
Larkspur, Recurved	*Delphinium recurvatum*	CA	Plant	BS
Larkspur, Umbrella	*Delphinium umbraculorum*	CA	Plant	BS
Larkspur, Wenatchee	*Delphinium viridescens*	OR	Plant	BS
Larkspur, White Rock	*Delphinium leucophaeum*	OR	Plant	BS
Larkspur, Willamette Valley	*Delphinium oreganum*	OR	Plant	BS
Layia, Beach	*Layia carnosa*	CA	Plant	FE
Layia, Colusa	*Layia septentrionalis*	CA	Plant	BS
Layia, Jones's	*Layia jonesii*	CA	Plant	BS
Layia, Pale-yellow	*Layia heterotricha*	CA	Plant	BS
Leadplant	*Amorpha canescens*	MT	Plant	BS
Legenere	*Legenere limosa*	CA	Plant	BS
Lemming, Northern Bog	*Synaptomys borealis*	ID, MT	Mammal	BS
Lettuce Lung	*Lobaria oregana*	CA	Plant	BS
Lewisia, Cantelow's	*Lewisia cantelovii*	CA	Plant	BS
Lewisia, Heckner's	*Lewisia cotyledon heckneri*	CA	Plant	BS
Lewisia, Purdy's	*Lewisia cotyledon purdyi*	OR	Plant	BS
Lichen, Cat Paw	*Nephroma bellum*	CA	Plant	BS
Lichen, Dot	*Physcia semipinnata*	ID, OR	Plant	BS
Lichen, Dusty Cartilige	*Ramalina pollinaria*	CA	Plant	BS
Lichen, Earth	*Catapyrenium congestum*	ID	Plant	BS
Lichen, Horse-hair	*Bryoria pseudocapillaris*	CA	Plant	BS
Lichen, Horse-hair	*Bryoria spiralifera*	CA	Plant	BS
Lichen, Idaho Range	*Xanthoparmelia idahoensis*	ID	Plant	BS
Lichen, Long-beard	*Usnea longissima*	CA	Plant	BS
Lichen, Matted	*Pannaria rubiginosa*	CA	Plant	BS
Lichen, Nail	*Pilophorus acicularis*	ID	Plant	BS
Lichen, Orange Bush	*Teloschistes flavicans*	CA	Plant	BS
Lichen, Shield	*Heterodermia leucomelos*	CA	Plant	BS
Lichen, Short-spored Jelly	*Collema curtisporum*	ID	Plant	BS
Lichen, Skin	*Dermatocarpon lorenzianum*	ID	Plant	BS

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Lichen, Worm	*Thamnolia vermicularis*	ID	Plant	BS
Lichen, Wovenspore	*Texosporium sancti-jacobi*	ID, OR	Plant	BS
Lichen, Yellow-twist Horse-hair	*Bryoria tortuosa*	CA	Plant	BS
Licorice-root, Calder's	*Ligusticum calderi*	AK	Plant	BS
Lily, Adobe	*Fritillaria pluriflora*	CA	Plant	BS
Lily, Western (Bog Lily)	*Lilium occidentale*	CA, OR	Plant	FE
Limpet, Banbury Springs	*Lanx species*	CA, ID	Snail	FE
Linanthus, Little San Bernardino Mtn	*Gilia maculata*	CA	Plant	BS
Linanthus, Mount Tedoc	*Linanthus nuttallii howellii*	CA	Plant	BS
Linanthus, Orcutt's	*Linanthus orcuttii*	CA	Plant	BS
Liverwort	*Chiloscyphus gemmiparus*	OR	Plant	BS
Liverwort	*Jamesoniella autumnalis heterostips*	OR	Plant	BS
Liverwort	*Sphaerocarpos hians*	OR	Plant	BS
Lizard, Blunt-nosed Leopard	*Gambelia silus*	CA	Reptile	FE
Lizard, California Horned	*Phrynosoma coronatum frontale*	CA	Reptile	BS
Lizard, Coachella Valley Fringe-toed	*Uma inornata*	CA	Reptile	FT
Lizard, Colorado Desert Fringe-toed	*Uma notata notata*	CA	Reptile	BS
Lizard, Cowle's Fringe-toed	*Uma notata rufopunctata*	AZ	Reptile	BS
Lizard, Desert Night	*Xantusia vigilis vigilis*	UT	Reptile	BS
Lizard, Desert Spiny	*Sceloporus magister*	UT	Reptile	BS
Lizard, Flat-tailed Horned	*Phrynosoma mcallii*	AZ, CA, CO	Reptile	BS
Lizard, Longnose Leopard	*Gambelia wislizenii*	CA	Reptile	BS
Lizard, Mojave Black-collared	*Crotaphytus bicinctores*	ID, UT	Reptile	BS
Lizard, Mojave Fringe-toed	*Uma scoparia*	CA	Reptile	BS
Lizard, Northern Alligator	*Elgaria coerulea*	ID	Reptile	W
Lizard, Northern Sagebrush	*Sceloporus graciosus graciosus*	AZ, CA	Reptile	BS
Lizard, Sand Dune	*Sceloporus arenicolus*	NM	Reptile	C
Lizard, Short-horned	*Phrynosoma doublassii*	NV	Reptile	BS
Lizard, Sierra Alligator	*Elgaria coerulea palmeri*	NV	Reptile	BS
Lizard, Texas Horned	*Phrynosoma cornutum*	AZ, CO, NM	Reptile	BS
Lizard, Utah Night	*Xantusia vigilis utahensis*	UT	Reptile	BS
Lobelia, Kalm's	*Lobelia kalmii*	OR	Plant	BS
Lobelia, Water	*Lobelia dortmanna*	OR	Plant	BS
Locoweed, Arctic	*Oxytropis arctica barnedyana*	AK	Plant	BS
Locoweed, Kobuk	*Oxytropis kobukensis*	AK	Plant	BS
Loeflingia, Sagebrush	*Loeflingia squarrosa artemisiarum*	CA	Plant	BS
Lomatium, Congdon's	*Lomatium congdonii*	CA	Plant	BS
Lomatium, Cook's (Desert Parsley)	*Lomatium cookii*	OR	Plant	FE
Lomatium, Ochoco	*Lomatium ochocense*	OR	Plant	BS
Lomatium, Owens Peak	*Lomatium shevockii*	CA	Plant	BS
Lomatium, Suksdorf's	*Lomatium suksdorfii*	OR	Plant	BS
Lompoc, Yerba Santa	*Eriodictyon capitatum*	CA	Plant	FE
Loon, Common	*Gavia immer*	MT	Bird	BS
Loon, Red-throated	*Gavia stellata*	AK	Bird	BS
Lotus, Red-flowered	*Lotus rubriflorus*	CA	Plant	BS
Lotus, Scrub	*Lotus argyraeus multicaulis*	NV	Plant	BS
Lousewort, Dwarf	*Pedicularis centranthera*	CA	Plant	BS
Lousewort, Hairy	*Pedicularis hirsuta*	AK	Plant	BS
Lousewort, Meadow	*Pedicularis crenata*	MT	Plant	BS
Lupine, Cutler's Spured	*Lupinus caudatus culteri*	UT	Plant	BS
Lupine, Holmgren	*Lupinus holmgrenianus*	NV	Plant	BS

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Lupine, Inch-high	*Lupinus uncialis*	CA, ID	Plant	BS
Lupine, Kincaid's	*Lupinus sulphureus kincaidii*	OR	Plant	FT
Lupine, Panamint Mountains	*Lupinus magnificus magnificus*	CA	Plant	BS
Lupine, Paradox Valley	*Lupinus crassus*	CO	Plant	BS
Lupine, Quincy	*Lupinus dalesiae*	CA	Plant	BS
Lupine, Sabine's	*Lupinus sabinianus*	OR	Plant	BS
Lupine, San Luis	*Lupinus ludovicianus*	CA	Plant	BS
Lupine, Shaggyhair	*Lupinus spectabilis*	CA	Plant	BS
Lynx, Canada	*Lynx canadensis*	AK, CO, ID, MT, OR, UT, WY	Mammal	FT
Madia, Showy	*Madia radiata*	CA	Plant	BS
Malacothrix, Carmel Valley	*Malacothrix saxatilis arachnoidea*	CA	Plant	BS
Mallow, Carmel Valley Bush	*Malacothamnus palmeri involucratus*	CA	Plant	BS
Mallow, Kern	*Eremalche kernensis*	CA	Plant	FE
Manzanita, Arroyo de la Cruz	*Arctostaphylos cruzensis*	CA	Plant	BS
Manzanita, Hooker's	*Arctostaphylos hookeri hookeri*	CA	Plant	BS
Manzanita, Ione	*Arctostaphylos myrtifolia*	CA	Plant	FT
Manzanita, Klamath	*Arctostaphylos klamathensis*	CA	Plant	BS
Manzanita, Monterey	*Arctostaphylos montereyensis*	CA	Plant	BS
Manzanita, Morro	*Arctostaphylos morroensis*	CA	Plant	FT
Manzanita, Nissenan	*Arctostaphylos nissenana*	CA	Plant	BS
Manzanita, Otay	*Arctostaphylos otayensis*	CA	Plant	BS
Manzanita, Sand Mesa	*Arctostaphylos rudis*	CA	Plant	BS
Manzanita, Sandmat	*Arctostaphylos pumila*	CA	Plant	BS
Manzanita, Santa Margarita	*Arctostaphylos pilosula*	CA	Plant	BS
Marcescent Dudleya	*Dudleya cymosa marcescens*	CA	Plant	FT
Mariposa Lily, Alkali	*Calochortus striatus*	CA, NV	Plant	BS
Mariposa Lily, Broad-fruit	*Calochortus nitidus*	ID, OR	Plant	BS
Mariposa Lily, Crinite	*Calochortus coxii*	OR	Plant	BS
Mariposa Lily, Green-band	*Calochortus macrocarpus maculosus*	ID, OR	Plant	BS
Mariposa Lily, Greene's	*Calochortus greenei*	CA, OR	Plant	BS
Mariposa Lily, Inyo	*Calochortus excavatus*	CA	Plant	BS
Mariposa Lily, Pleasant Valley	*Calochortus clavatus avius*	CA	Plant	BS
Mariposa Lily, San Luis	*Calochortus obispoensis*	CA	Plant	BS
Mariposa Lily, San Luis Obispo	*Calochortus simulans*	CA	Plant	BS
Mariposa Lily, Shasta River	*Calochortus monanthus*	CA	Plant	BS
Mariposa Lily, Siskiyou	*Calochortus persistens*	OR	Plant	C
Mariposa Lily, Umpqua	*Calochortus umpquaensis*	OR	Plant	C
Marten	*Martes americana*	UT	Mammal	BS
Martin, Purple	*Progne subis*	MT, OR	Bird	BS
Massasauga	*Sistrurus catenatus*	CO	Reptile	BS
Meadowfoam, Bellinger's	*Limnanthes floccosa bellingeriana*	CA, OR	Plant	BS
Meadowfoam, Butte County	*Limnanthes floccosa californica*	CA	Plant	FE
Meadowfoam, Slender	*Limnanthes gracilis gracilis*	OR	Plant	BS
Meadowfoam, Wooly	*Limnanthes floccosa grandiflora*	OR	Plant	FE
Meadowlark, Western	*Sturnella neglecta*	OR	Bird	BS
Meadowrue, Alpine	*Thalictrum alpinum*	MT	Plant	BS
Meadowrue, Purple	*Thalictrum dasycarpum*	ID	Plant	BS
Meesia	*Meesia longiseta*	CA	Insect	BS
Mesa-mint, Otay	*Pogogyne nudiuscula*	CA	Plant	FE

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Microseris, Detling's	*Microseris laciniata detlingii*	CA, OR	Plant	BS
Milk-vetch Applegate's	*Astragalus applegatei*	OR	Plant	FE
Milk-vetch, Ames' (Suksdorf's Milk-vetch)	*Astragalus pulsiferae suksdorfii*	CA, OR	Plant	BS
Milk-vetch, Aquarius	*Astragalus newberryi aquarii*	AZ	Plant	BS
Milk-vetch, Ash Meadows	*Astragalus phoenix*	NV	Plant	FT
Milk-vetch, Ash Valley	*Astragalus anxius*	CA	Plant	BS
Milk-vetch, Barren	*Astragalus sterilis*	ID	Plant	BS
Milk-vetch, Barr's	*Astragalus barrii*	MT	Plant	BS
Milk-vetch, Bitterroot	*Astragalus scaphoides*	MT	Plant	BS
Milk-vetch, Black (Black Woolly-pod Milk-vetch)	*Astragalus funereus*	CA, NV	Plant	BS
Milk-vetch, Brandegee	*Astragalus brandegeei*	CO	Plant	BS
Milk-vetch, Braunton's	*Astragalus brauntonii*	CA	Plant	FE
Milk-vetch, Challis	*Astragalus amblytropis*	ID	Plant	BS
Milk-vetch, Cisco	*Astragalus sabulosus*	UT	Plant	BS
Milk-vetch, Cliff	*Astragalus cremnophylax myriorraphis*	AZ	Plant	BS
Milk-vetch, Clokey	*Astragalus aequalis*	NV	Plant	BS
Milk-vetch, Coachella Valley	*Astragalus lentiginosus coachellae*	CA	Plant	FE
Milk-vetch, Columbia	*Astragalus columbianus*	OR	Plant	BS
Milk-vetch, Cotton's	*Astragalus australis olympicus*	OR	Plant	BS
Milk-vetch, Cronquist	*Astragalus cronquistii*	CO, UT	Plant	BS
Milk-vetch, Currant	*Astragalus uncialis*	NV, UT	Plant	BS
Milk-vetch, Cushenbury	*Astragalus albens*	CA	Plant	FE
Milk-vetch, Cushion	*Astragalus aretioides*	CO, MT	Plant	BS
Milk-vetch, Darwin Mesa	*Astragalus atratus mensanus*	CA	Plant	BS
Milk-vetch, Deane's	*Astragalus deanei*	CA	Plant	BS
Milk-vetch, Debeque	*Astragalus debequaeus*	CO	Plant	BS
Milk-vetch, Debris	*Astragalus detritalis*	CO	Plant	BS
Milk-vetch, Desert	*Astragalus desereticus*	UT	Plant	FT
Milk-vetch, Diamond Butte	*Astragalus toanus scidulus*	AZ	Plant	BS
Milk-vetch, Drummond's	*Astragalus drummondii*	ID	Plant	BS
Milk-vetch, Dubois	*Astragalus gilviflorus purpureus*	WY	Plant	BS
Milk-vetch, Duchesne	*Astragalus duchesnensis*	CO	Plant	BS
Milk-vetch, Escarpment	*Astragalus striatoflorus*	UT	Plant	BS
Milk-vetch, Ferris's	*Astragalus tener ferrisiae*	CA	Plant	BS
Milk-vetch, Ferron	*Astragalus musiniensis*	CO	Plant	BS
Milk-vetch, Field	*Astragalus agrestis*	CA	Plant	BS
Milk-vetch, Fish Slough	*Astragalus lentiginosus piscinensis*	CA	Plant	FT
Milk-vetch, Fisher Tower's	*Astragalus piscator*	CO	Plant	BS
Milk-vetch, Four-wing	*Astragalus tetrapterus*	ID	Plant	BS
Milk-vetch, Geyer	*Astragalus geyeri*	CA	Plant	BS
Milk-vetch, Gilman	*Astragalus gilmanii*	NV	Plant	BS
Milk-vetch, Goose Creek	*Astragalus anserinus*	ID, NV, UT	Plant	BS
Milk-vetch, Grand Junction	*Astragalus linifolius*	CO	Plant	BS
Milk-vetch, Gray's	*Astragalus grayi*	MT	Plant	BS
Milk-vetch, Green River	*Astragalus pubentissimus*	UT	Plant	BS
Milk-vetch, Gumbo	*Astragalus ampullaris*	UT	Plant	BS
Milk-vetch, Gunnison	*Astragalus anisus*	CO	Plant	BS
Milk-vetch, Halfring	*Astragalus mohavensis hemigyrus*	NV	Plant	BS
Milk-vetch, Hamilton's	*Astragalus hamiltonii*	UT	Plant	BS

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Milk-vetch, Helitrope	*Astragalus montii*	UT	Plant	FT
Milk-vetch, Holmgren	*Astragalus holmgreniorum*	AZ, UT	Plant	FE
Milk-vetch, Horseshoe	*Astragalus equisolensis*	UT	Plant	C
Milk-vetch, Huachuca	*Astragalus hypoxylus*	AZ	Plant	BS
Milk-vetch, Humbolt	*Astragalus agnicidus*	CA	Plant	BS
Milk-vetch, Hyattville	*Astragalus jejunus articulatus*	WY	Plant	BS
Milk-vetch, Inyo	*Astragalus inyoensis*	NV	Plant	BS
Milk-vetch, Jacumba	*Astragalus douglasii perstrictus*	CA	Plant	BS
Milk-vetch, Jepson's	*Astragalus rattanii jepsonianus*	CA	Plant	BS
Milk-vetch, Knight's	*Astragalus knightii*	NM	Plant	BS
Milk-vetch, Lamoille Canyon	*Astragalus robbinsii occidentalis*	NV	Plant	BS
Milk-vetch, Lane Mountain	*Astragalus jaegerianus*	CA	Plant	FE
Milk-vetch, Least Bladdery	*Astragalus microcystis*	ID	Plant	BS
Milk-vetch, Lemhi	*Astragalus aquilonius*	ID	Plant	BS
Milk-vetch, Lemmon's	*Astragalus lemmonii*	CA	Plant	BS
Milk-vetch, Lens-pod	*Astragalus lentiformis*	CA	Plant	BS
Milk-vetch, Lesser Rushy	*Astragalus convallarius convallarius*	MT	Plant	BS
Milk-vetch, Lonesome (Weak Milk-vetch)	*Astragalus solitarius*	NV	Plant	BS
Milk-vetch, Long Valley	*Astragalus johannis-howellii*	CA	Plant	BS
Milk-vetch, Lost River	*Astragalus amnis-amissi*	ID	Plant	BS
Milk-vetch, Mancos	*Astragalus humillimus*	CO, NM	Plant	FE
Milk-vetch, Meadow	*Astragalus diversifolius*	ID	Plant	BS
Milk-vetch, Mokiak	*Astragalus mokiacensis*	NV	Plant	BS
Milk-vetch, Mourning	*Astragalus atratus inseptus*	ID	Plant	BS
Milk-vetch, Mulford's	*Astragalus mulfordiae*	ID	Plant	BS
Milk-vetch, Naturita	*Astragalus naturitensis*	CO	Plant	BS
Milk-vetch, Needle Mountains (Peck Station Milk-vetch)	*Astragalus eurylobus*	NV	Plant	BS
Milk-vetch, Nelson	*Astragalus nelsonianus*	CO, WY	Plant	BS
Milk-vetch, Newberry's	*Astragalus newberryi castoreus*	ID	Plant	BS
Milk-vetch, Osgood Mountains	*Astragalus yoder-williamsii*	ID	Plant	BS
Milk-vetch, Osterhout	*Astragalus osterhoutii*	CO	Plant	FE
Milk-vetch, Packard's	*Astragalus cusickii packardiae*	ID	Plant	BS
Milk-vetch, Painted	*Astragalus ceramicus apus*	MT	Plant	BS
Milk-vetch, Payson's	*Astragalus paysonii*	ID	Plant	BS
Milk-vetch, Picabo	*Astragalus oniciformis*	ID	Plant	BS
Milk-vetch, Pierson's	*Astragalus magdalenae peirsonii*	CA	Plant	FT
Milk-vetch, Plains	*Astragalus gilviflorus*	ID	Plant	BS
Milk-vetch, Pohill's	*Astragalus lentiginosus pohilli*	UT	Plant	BS
Milk-vetch, Precocious	*Astragalus proimanthus*	WY	Plant	BS
Milk-vetch, Pulsifer's	*Astragalus pulsiferae pulsiferae*	CA	Plant	BS
Milk-vetch, Railhead	*Astragalus terminalis*	ID, MT	Plant	BS
Milk-vetch, Ripley's	*Astragalus ripleyi*	CO, NM	Plant	BS
Milk-vetch, San Rafeal	*Astragalus rafaelensis*	CO	Plant	BS
Milk-vetch, Sandstone	*Astragalus sesquiflorus*	CO	Plant	BS
Milk-vetch, Shevock's	*Astragalus shevockii*	CA	Plant	BS
Milk-vetch, Shivwitz	*Astragalus ampullarioides*	UT	Plant	FE
Milk-vetch, Silver	*Astragalus subcinereus*	UT	Plant	BS
Milk-vetch, Silverleaf	*Astragalus argophyllus argophyllus*	CA	Plant	BS
Milk-vetch, Skiff	*Astragalus microcymbus*	CO	Plant	BS

Common Name	Scientific Name	State	Class	Status[1]
Milk-vetch, Spine-noded	*Peteria thompsoniae*	ID	Plant	BS
Milk-vetch, Spring Mountain	*Astragalus remotus*	NV	Plant	BS
Milk-vetch, Starveling	*Astragalus jejunus jejunus*	CO, ID	Plant	BS
Milk-vetch, Tiehm's	*Astragalus tiehmii*	CA, NV	Plant	BS
Milk-vetch, Tonopah	*Astragalus pseudiodanthus*	CA	Plant	BS
Milk-vetch, Toquima	*Astragalus toquimanus*	NV	Plant	BS
Milk-vetch, Trelease's	*Astragalus racemosus treleasei*	WY	Plant	BS
Milk-vetch, Triple-ribbed	*Astragalus tricarinatus*	CA	Plant	FE
Milk-vetch, Trout Creek	*Astragalus salmonis*	ID	Plant	BS
Milk-vetch, Two-grooved	*Astragalus bisulcatus bisulcatus*	ID	Plant	BS
Milk-vetch, Walker Pass	*Astragalus ertterae*	CA	Plant	BS
Milk-vetch, Webber's	*Astragalus webberi*	CA	Plant	BS
Milk-vetch, Whited's	*Astragalus sinuatus*	OR	Plant	BS
Milk-vetch, Wind River	*Astragalus oreganus*	MT	Plant	BS
Milkweed, Dwarf	*Asclepias uncialis*	CO	Plant	BS
Milkweed, Narrowleaf	*Asclepias stenophylla*	MT	Plant	BS
Milkweed, Ruth's	*Asclepias uncialis ruthiae*	NV	Plant	BS
Milkweed, Welsh's	*Asclepias welshii*	AZ, UT	Plant	FT
Minnow, Loach	*Rhinichthys cobitis*	AZ, NM	Fish	FT
Minnow, Rio Grande Silvery	*Hybognathus amarus*	NM	Fish	FE
Mistmaiden, Thompson	*Romanzoffia thompsonii*	OR	Plant	BS
Mole, Coast	*Scapanus orarius*	ID	Mammal	BS
Monardella, Crisp	*Monardella crispa*	CA	Plant	BS
Monardella, Flax-like	*Monardella linoides oblonga*	CA	Plant	BS
Monardella, Robison	*Monardella robisonii*	CA	Plant	BS
Monardella, San Benito	*Monardella Antonia benitensis*	CA	Plant	BS
Monardella, San Luis Obispo	*Monardella frutescens*	CA	Plant	BS
Monardella, Sweet-smelling	*Monardella beneolens*	CA	Plant	BS
Monardella, Veiny	*Monardella douglasii venosa*	CA	Plant	BS
Monkeyflower, Calico	*Mimulus pictus*	CA	Plant	BS
Monkeyflower, Disappearing	*Mimulus evanescens*	CA, OR	Plant	BS
Monkeyflower, Dwarf Purple	*Mimulus nanus*	MT	Plant	BS
Monkeyflower, Eastwood's	*Mimulus eastwoodiae*	CO	Plant	BS
Monkeyflower, Kaweah	*Mimulus norrisii*	CA	Plant	BS
Monkeyflower, Liverwort	*Mimulus jungermannioides*	OR	Plant	BS
Monkeyflower, Membrane-leaved	*Mimulus hymenophyllus*	OR	Plant	BS
Monkeyflower, Mojave	*Mimulus mohavensis*	CA	Plant	BS
Monkeyflower, Shevock's	*Mimulus shevockii*	CA	Plant	BS
Monkeyflower, Slender-stalked	*Mimulus gracilipes*	CA	Plant	BS
Monkeyflower, Slender-stemmed	*Mimulus filicaulis*	CA	Plant	BS
Monkeyflower, Spacious	*Mimulus washingtonensis (ampliatus)*	ID	Plant	BS
Monkeyflower, Square-stemmed	*Mimulus ringens*	MT	Plant	BS
Moonpod, Desert	*Selinocarpus diffusus*	AZ	Plant	BS
Moonpod, Goosefoot	*Ammocodon chenopodioides*	AZ	Plant	BS
Moon-shrub, Northern	*Dendriscocaulon intricatulum*	CA	Plant	BS
Moonwort, Mingan	*Botrychium minganense*	ID	Plant	BS
Moonwort, Northern	*Botrychium pinnatum*	ID	Plant	BS
Moonwort, Scalloped (Dainty Moonwort)	*Botrychium crenulatum*	CA, NV, OR	Plant	BS
Moonwort, Slender	*Botrychium lineare*	CO, ID, OR	Plant	C
Moonwort, Stalked	*Botrychium pedunculosum*	OR	Plant	BS

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Moonwort, Twin-spiked	*Botrychium paradoxum*	OR	Plant	BS
Moonwort; Upward-lobed	*Botrychium ascendens*	AK, OR	Plant	BS
Morning-glory, Butte County	*Calystegia atriplicifolia buttensis*	CA	Plant	BS
Morning-glory, South Coast Range	*Calystegia collina venusta*	CA	Plant	BS
Morning-glory, Stebbins'	*Calystegia stebbinsii*	CA	Plant	FE
Moss	*Encalypta brevicolla crumiana*	OR	Bryophyte	BS
Moss	*Limbella fryei*	OR	Plant	BS
Moss, Gold Butte	*Didymodon nevadensis*	NV	Plant	BS
Moss, Worm	*Scorpidium scorpioides*	MT	Plant	BS
Moth, Kern Primrose Sphinx	*Euproserpinus euterpe*	CA	Insect	FT
Mountain Balm, Indian Knob	*Eriodictyon altissimum*	CA	Plant	FE
Mountain-parsley, Purple	*Oreonana purpurascens*	CA	Plant	BS
Mountainsnail, Mineral Creek	*Oreohelix pilsbryi*	NM	Crustacean	BS
Mountainsnail, Ogden Deseret	*Oreohelix periphera*	UT	Snail	C
Mouse, Cactus	*Peromyscus torridus*	UT	Mammal	BS
Mouse, Dark Kangaroo	*Microdipodops megacephalus*	ID	Mammal	BS
Mouse, Desert Valley Kangaroo	*Microdipodops megacephalus albiventer*	NV	Mammal	BS
Mouse, Fletcher Dark Kangaroo	*Microdipodops megacephalus nasutus*	NV	Mammal	BS
Mouse, Little Pocket	*Perognathus longimembris*	ID	Mammal	BS
Mouse, Meadow Jumping	*Zapus hudsonius*	MT	Mammal	BS
Mouse, New Mexican Jumping	*Zapus hudsonius luteus*	NM	Mammal	BS
Mouse, Northern Rock	*Peromyscus nasutus*	UT	Mammal	BS
Mouse, Olive-backed Pocket	*Perognathus fasciatus*	UT	Mammal	BS
Mouse, Preble's Meadow Jumping	*Zapus hudsonius preblei*	CO, WY	Mammal	FT
Mouse, Rock Pocket	*Chaetodipus intermedius*	UT	Mammal	BS
Mouse, San Joaquin Pocket	*Perognathus inornatus inornatus*	CA	Mammal	BS
Mouse, Southern Grasshopper	*Onychomys torridus*	UT	Mammal	BS
Mouse, Tulare Grasshopper	*Onychomys torridus tularensis*	CA	Mammal	BS
Mouse, Yellow-eared Pocket	*Perognathus xanthonotus*	CA	Mammal	BS
Mousetail, Ostler's	*Ivesia shockleyi ostleri*	UT	Plant	BS
Mousetail, Sessile	*Myosurus sessilis*	OR	Plant	BS
Mudwort, Chiricahua	*Limosella pubiflora*	NM	Plant	BS
Mule ears, El Dorado	*Wyethia reticulata*	CA	Plant	BS
Murrelet, Kittliz's	*Brachyramphus brevirostris*	AK	Bird	BS
Murrelet, Marbled	*Brachyramphus marmoratus marmoratus*	AK, CA, OR	Bird	FT
Mushroom, Little Brown	*Clitocybe subditopoda*	CA	Fungi	BS
Mushroom, Little Brown	*Hydropus marginellus*	CA	Fungi	BS
Mushroom, Little Brown	*Mycena quinaultensis*	CA	Fungi	BS
Mushroom, Little Green	*Dermocybe humboldtensis*	CA, OR	Fungi	BS
Musk-root	*Adoxa moschatellina*	MT	Plant	BS
Muskrat, Pecos River	*Ondatra zibethicus ripensis*	NM	Mammal	BS
Myotis, California	*Myotis californicus*	ID	Mammal	BS
Myotis, Cave	*Myotis velifer*	AZ, CA, NM, NV	Mammal	BS
Myotis, Fringed	*Myotis thysanodes*	AZ, CA, CO, ID, NM, NV, UT, WY	Mammal	BS
Myotis, Little Brown	*Myotis lucifugus*	NV	Mammal	BS
Myotis, Long-eared	*Myotis evotis*	AZ, CA, NM, NV, WY	Mammal	BS

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Myotis, Long-eared	*Myotis evotis*	ID	Mammal	W
Myotis, Long-legged	*Myotis volans*	AZ, NM, NV	Mammal	BS
Myotis, Long-legged	*Myotis volans*	ID	Mammal	W
Myotis, Small-footed (Western Small-footed Myoitis)	*Myotis ciliolabrum*	AZ, CA, ID, NM, NV	Mammal	BS
Myotis, Small-footed (Western Small-footed Myotis)	*Myotis ciliolabrum*	ID	Mammal	W
Myotis, Yuma	*Myotis yumanensis*	CA, CO, ID, NM	Mammal	BS
Nama	*Nama densum*	MT	Plant	BS
Naucorid, Ash Meadows	*Ambrysus amargosus*	NV	Insect	FT
Navarretia, Baker's	*Navarretia leucocephala bakeri*	CA	Plant	BS
Navarretia, Marigold	*Navarretia tagetina*	OR	Plant	BS
Navarretia, Piute Mountains	*Navarretia setiloba*	CA	Plant	BS
Navarretia, Willamette	*Navarretia willamettensis*	OR	Plant	BS
Necklacepod, Western	*Sophora leachiana*	OR	Plant	BS
Needle, Giant Spanish	*Palafoxia arida gigantea*	CA	Plant	BS
Needlegrass, Green	*Stipa viridula*	ID	Plant	BS
Neoparrya, Rock Loving	*Neoparrya lithophila*	CO	Plant	BS
Neststraw, Mason	*Stylocline masonii*	CA	Plant	BS
Neststraw, Oil	*Stylocline citroleum*	CA	Plant	BS
Night-blooming Cactus, Desert	*Peniocereus greggii greggii*	NM	Plant	BS
Nighthawk, Common	*Chordeiles minor*	OR	Bird	BS
Niterwort, Amargosa	*Nitrophila mohavensis*	CA, NV	Plant	FE
Northern-rockcress, Low	*Braya humulis*	MT	Plant	BS
Nuthatch, Pygmy	*Sitta pygmaea*	OR	Bird	BS
Nuthatch, Pygmy	*Sitta pygmaea*	ID	Bird	W
Nymph, Big Smoky Wood	*Cercyonis oetus alkalorum*	NV	Insect	BS
Nymph, Pallid Wood	*Cercyonis oetus pallescens*	NV	Insect	BS
Nymph, White River Wood	*Cercyonis pegala carsonensis*	NV	Insect	BS
Oak, Bur	*Quercus macrocarpa*	MT	Plant	BS
Ocelot	*Felis pardalis*	AZ	Mammal	FE
Onion, Aase's	*Allium aaseae*	ID	Plant	BS
Onion, Geyers	*Allium geyeri chatterleyi*	UT	Plant	BS
Onion, Goodding's	*Allium gooddingii*	NM	Plant	BS
Onion, Jepson's	*Allium jepsonii*	CA	Plant	BS
Onion, Munz's	*Allium munzii*	CA	Plant	FT
Onion, Rawhide Hill	*Allium tuolumnense*	CA	Plant	BS
Onion, Spanish Needle	*Allium shevockii*	CA	Plant	BS
Onion, Tolmie's	*Allium tolmiei persimile*	ID	Plant	BS
Onion, Two-headed	*Allium anceps*	ID	Plant	BS
Orache, Earlmart	*Atriplex erecticaulis*	CA	Plant	BS
Orache, Subtle	*Atriplex subtilis*	CA	Plant	BS
Orange Peel Fungus, Stalked	*Sowerbyella rhenana*	CA	Fungi	BS
Orchid, Chatterbox	*Epipactis gigantea*	ID	Plant	BS
Orchid, Western Prairie Fringed	*Platanthera praeclara*	MT, WY	Plant	FT
Orchid, Yellow Wide-lip	*Liparis loeselii*	OR	Plant	BS
Orcytes	*Orcytes nevadensis*	CA, NV	Plant	BS
Orthocarpus, Shasta	*Orthocarpus pachystachyus*	CA	Plant	BS
Orthotrichium, Hall's	*Orthotrichium hallii*	ID	Plant	BS
Orthotrichium, Shevock's	*Orthotrichium shevockii*	CA	Plant	BS

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Osprey	*Pandion haliaetus*	UT	Bird	BS
Otter, Northern River	*Lutra canadensis*	UT, WY	Mammal	BS
Otter, River	*Lutra canadensis lataxina*	AZ, NM, NV, WY	Mammal	BS
Otter, Southwestern River	*Lutra canadensis sonora*	NM	Mammal	BS
Owl, Boreal	*Aegolius funereus*	MT	Bird	BS
Owl, Boreal	*Aegolius funereus*	ID	Bird	W
Owl, Burrowing (Western Owl)	*Athene cunicularia hypugaea*	AZ, CA, MT, NM, NV, OR, UT, WY	Bird	BS
Owl, Burrowing (Western Owl)	*Athene cunicularia hypugaea*	ID	Bird	W
Owl, California Spotted	*Strix occidentalis occidentalis*	CA	Bird	BS
Owl, Flammulated	*Otus flammeolus*	ID, MT, NV, OR	Bird	BS
Owl, Great Gray	*Strix nebulosa*	MT, OR	Bird	BS
Owl, Great Gray	*Strix nebulosa*	ID	Bird	W
Owl, Long-eared	*Asio otus*	NV	Bird	BS
Owl, Mexican Spotted	*Strix occidentalis lucida*	AZ, CA, CO, NM, UT	Bird	FT
Owl, Northern Spotted	*Strix occidentalis caurina*	CA, OR	Bird	FT
Owl, Short-eared	*Asio flammeus*	ID, NV, UT	Bird	BS
Owl's-clover, Fleshy	*Castilleja campestris succulenta*	CA	Plant	FT
Owl's-clover, Humbolt Bay	*Castilleja ambigua humboltiensis*	CA	Plant	BS
Owl's-clover, Rosy	*Orthocarpus bracteosus*	OR	Plant	BS
Paddlefish	*Polyodon spathula*	MT	Fish	BS
Paintbrush, Aquarius	*Castilleja aquariensis*	UT	Plant	C
Paintbrush, Fraternal	*Castilleja fraterna*	OR	Plant	BS
Paintbrush, Green-tinged	*Castilleja chlorotica*	OR	Plant	BS
Paintbrush, Mendocino Coast (Indian)	*Castilleja mendocinensis*	CA, OR	Plant	BS
Paintbrush, Obispo	*Castilleja densiflora obispoensis*	CA	Plant	BS
Paintbrush, Ornate	*Castilleja ornata*	NM	Plant	BS
Paintbrush, Purple Alpine	*Castilleja rubida*	OR	Plant	BS
Paintbrush, Steens Mountain	*Castilleja pilosa steenensis*	OR	Plant	BS
Panicgrass, Scribner's	*Dichanthelium oligosanthes scribnerianum*	MT	Plant	BS
Paronychia, Ahart's	*Paronychia ahartii*	CA	Plant	BS
Peaclam, Montane	*Pisidium ultramontanum*	OR	Snail	BS
Pearpod, Talapoosa Peak	*Stroganowia tiehmii*	NV	Plant	BS
Peavine, Thin-leaved	*Lathyrus holochlorus*	OR	Plant	BS
Pebblesnail, Casebeer	*Fluminicola* sp. *nov.*	OR	Snail	BS
Pebblesnail, Columbia	*Fluminicola columbianus*	ID	Snail	BS
Pebblesnail, Diminutive	*Fluminicola* sp.	OR	Snail	BS
Pebblesnail, Fall Creek	*Fluminicola* sp.	OR	Snail	BS
Pebblesnail, Keene Creek	*Fluminicola* sp.	OR	Snail	BS
Pebblesnail, Klamath	*Fluminicola* sp.	OR	Snail	BS
Pebblesnail, Klamath Rim	*Fluminicola* sp.	OR	Snail	BS
Pebblesnail, Lake of the Woods	*Fluminicola* sp.	OR	Snail	BS
Pebblesnail, Newrite	*Fluminicola* sp.	OR	Snail	BS
Pebblesnail, Tigerlily	*Fluminicola* sp.	OR	Snail	BS
Pebblesnail, Toothed	*Fluminicola* sp.	OR	Snail	BS

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Pelican, American White	*Pelecanus erthrorhynchos*	CO, ID, UT	Bird	BS
Pelican, Brown	*Pelecanus occidentalis*	AZ, CA, OR	Bird	FE
Pennycress, Meadow	*Thlaspi parviflorum*	MT	Plant	BS
Pennyroyal, Todson's	*Hedeoma todsenii*	NM	Plant	FE
Penstemon, Barrett's	*Penstemon barrettiae*	OR	Plant	BS
Penstemon, Blowout	*Penstemon haydenii*	WY	Plant	FE
Penstemon, Idaho	*Penstemon idahoensis*	ID, UT	Plant	BS
Penstemon, Janish's	*Penstemon janishiae*	ID	Plant	BS
Penstemon, Lemhi	*Penstemon lemhiensis*	ID, MT	Plant	BS
Penstemon, Peck's	*Penstemon peckii*	OR	Plant	BS
Penstemon, Pinyon	*Penstemon pinorum*	UT	Plant	BS
Pentachaeta, Slender	*Pentachaeta exilis aeolica*	CA	Plant	BS
Peppergrass, Borrego Valley	*Lepidium flavum felipense*	CA	Plant	BS
Peppergrass, Davis'	*Lepidium davisii*	ID	Plant	BS
Peppergrass, Entire-leaved	*Lepidium integrifolium iintergrifoli*	WY	Plant	BS
Peppergrass, Huber's	*Lepidium huberi*	UT	Plant	BS
Peppergrass, Jared's	*Lepidium jaredii jaredii*	CA	Plant	BS
Peppergrass, Mountain	*Lepidium montanum claronense*	UT	Plant	BS
Peppergrass, Ostler's	*Lepidium ostleri*	UT	Plant	BS
Peppergrass, Panoch	*Lepidium jaredii album*	CA	Plant	BS
Peppergrass, Slickspot	*Lepidium papilliferum*	ID	Plant	BS
Pepperweed, Barneby	*Lepidium barnebyanum*	UT	Plant	FE
Phacelia, Atwood's	*Phacelia pulchella atwoodii*	UT	Plant	BS
Phacelia, Cinder	*Phacelia serrata*	NM	Plant	BS
Phacelia, Clay	*Phacelia argillacea*	UT	Plant	FE
Phacelia, Cooke's	*Phacelia cookei*	CA	Plant	BS
Phacelia, Cronquist's	*Phacelia cronquistiana*	UT	Plant	BS
Phacelia, Death Valley Round-leaved	*Phacelia mustelina*	ID	Plant	BS
Phacelia, Debeque	*Phacelia submutica*	CO	Plant	C
Phacelia, Drab	*Phacelia indecora*	UT	Plant	BS
Phacelia, Least (Dwarf Phacelia)	*Phacelia minutissima*	ID, NV, OR	Plant	BS
Phacelia, Hoary	*Phacelia incana*	ID	Plant	BS
Phacelia, Mackenzie's	*Phacelia lutea mackenzieorum*	OR	Plant	BS
Phacelia, Malheur Yellow	*Phacelia lutea calva*	ID	Plant	BS
Phacelia, Mono (Mono County Phacelia)	*Phacelia monoensis*	CA, NV	Plant	BS
Phacelia, Mount Diablo	*Phacelia phacelioides*	CA	Plant	BS
Phacelia, Nash's	*Phacelia nashiana*	CA	Plant	BS
Phacelia, Nine Mile Canyon	*Phacelia novenmillensis*	CA	Plant	BS
Phacelia, North Park	*Phacelia formosula*	CO	Plant	FE
Phacelia, Obscure	*Phacelia inconspicua*	ID	Plant	BS
Phacelia, Parish (Playa Phacelia)	*Phacelia parishii*	AZ, CA, NV	Plant	BS
Phacelia, Playa	*Phacelia inundata*	CA, OR, UT	Plant	BS
Phacelia, Scott Valley	*Phacelia greenei*	CA	Plant	BS
Phacelia, Silvery	*Phacelia argentea*	OR	Plant	BS
Phacelia, Siskiyou	*Phacelia leonis*	CA, OR	Plant	BS
Phacelia, Sticky	*Phacelia lenta*	OR	Plant	BS
Phacelia, Utah	*Phacelia utahensis*	UT	Plant	BS
Phaeocollybia	*Phaeocollybia gregaria*	OR	Fungi	BS
Phaeocollybia	*Phaeocollybia oregonensis*	OR	Fungi	BS
Phaeocollybia	*Phaeocollybia pseudofestiva*	CA	Fungi	BS

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Phaeocollybia	*Phaeocollybia scatesiae*	CA	Fungi	BS
Phaeocollybia	*Phaeocollybia spadicea*	CA	Fungi	BS
Phaeocollybia, California	*Phaeocollybia californica*	CA, OR	Fungi	BS
Phaeocollybia, Olive	*Phaeocollybia olivacea*	CA, OR	Fungi	BS
Phaeocollybia, Spruce	*Phaeocollybia piceae*	CA	Fungi	BS
Phainopepla	*Phainopepla nitens*	NV, OR	Bird	BS
Phalaropus, Wilson's	*Phalaropus tricolor*	ID	Bird	W
Phlox, Beaver Rim	*Phlox pungens*	WY	Plant	BS
Phlox, Eureka	*Phlox hirsuta*	CA	Plant	FE
Phlox, Plains	*Phlox andicola*	MT	Plant	BS
Physa (Snail), Hotspring	*Physella* sp.	OR	Snail	BS
Physa (Snail), Rotund	*Physella columbiana*	OR	Snail	BS
Pika	*Ochotona princeps*	UT	Mammal	BS
Pikeminnow (Squawfish), Colorado	*Ptychocheilus lucius*	AZ	Fish	FE
Pikeminnow (Squawfish), Colorado	*Ptychocheilus lucius*	CA, CO, NM, UT, WY	Fish	FE
Pincushion Cactus, Brady	*Pediocactus bradyi*	AZ	Plant	FE
Pincushion Cactus, Kaibab	*Pediocactus paradinei*	AZ	Plant	BS
Pincushion Cactus, Nye	*Scleroccactus nyensis*	NV	Plant	BS
Pincusion Cactus, Schlesser's	*Scleroccactus schlesseri*	NV	Plant	BS
Pincusion Cactus, Siler	*Pediocactus sileri*	AZ, UT	Plant	FT
Pine, Washoe	*Pinus washoensis*	NV	Plant	BS
Pitcher-sage, Gander's	*Lepechinia ganderi*	CA	Plant	BS
Plover, Mountain	*Charadrius montanus*	AZ, CA, CO, MT, NM, NV, OR, UT, WY	Bird	BS
Plover, Piping	*Charadrius melodus*	CO, MT, NM, WY	Bird	FT
Plover, Western Snowy	*Charadrius alexandrinus nivosus*	CA, CO, NV, OR	Bird	FT
Podistera, Yukon	*Podistera yukonensis*	AK	Plant	BS
Pogogyne, Profuse-flowered	*Pogogyne floribunda*	CA, OR	Plant	BS
Polemonium, Great	*Polemonium carneum*	OR	Plant	BS
Polemonium, Washington	*Polemonium pectinatum*	OR	Plant	BS
Polypore, Blue-capped	*Albatrellus flettii*	CA	Fungi	BS
Polypore, Blue-pored	*Albatrellus caeruleoporus*	CA	Fungi	BS
Polypore, Noble	*Bridgeoporus nobilissimus*	OR	Plant	BS
Pondsnail, Bonneville	*Stagnicola bonnevillensis*	UT	Snail	C
Poolfish, Pahrump	*Empetrichthys latus*	NV	Fish	FE
Popcornflower, Coral Seeded	*Plagiobothrys figuratus corallicarpa*	OR	Plant	BS
Popcornflower, Hooked	*Plagiobothrys uncinatus*	CA	Plant	BS
Popcornflower, Rough	*Plagiobothrys hirtus*	OR	Plant	FE
Popcornflower, Slender-branched	*Plagiobothrys leptocladus*	MT	Plant	BS
Poppy, Diamond-petaled California	*Eschscholzia rhombipetala*	CA	Plant	BS
Poppy, Red Rock	*Eschscholzia minutiflora twisselman*	CA	Plant	BS
Poreleaf, Pygmy	*Porophyllum pygmaeum*	NV	Plant	BS
Prairie Chicken, Lesser	*Tympanuchus pallidicinctus*	CO, NM	Bird	C
Prairie-clover, Canyonlands	*Dalea flavescens*	UT	Plant	BS
Prairie Dog, Arizona Black-tailed	*Cynomys ludovicianus arizonensis*	NM	Mammal	C
Prairie Dog, Black-tailed	*Cynomys ludovicianus*	AZ, CO, ID, MT, NM, WY	Mammal	C

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Prairie Dog, Gunnison's	*Cynomys gunnisoni*	NM	Mammal	BS
Prairie Dog, Utah	*Cynomys parvidens*	UT	Mammal	FT
Prairie Dog, White-tailed	*Cynomys leucurus*	UT, WY	Mammal	BS
Prairie Rocket, Narrow-leaved	*Erysimum asperum angustatum*	AK	Plant	BS
Prickly phlox, Bruneau River	*Leptodactylon glabrum*	ID, NV	Plant	BS
Prickly phlox, Hazel's	*Leptodactylon pungens hazeliae*	ID, OR	Plant	BS
Prickly phlox, Mat	*Leptodactylon caespitosum*	MT	Plant	BS
Pricklypear, Sand (El Paso Pricklypear)	*Opuntia xcubensis (militaris x stricta)*	NM	Plant	C
Pricklypear, Sacramento	*Argemone pleiacantha pinnatisecta*	NM	Plant	FE
Primrose, Alkali	*Primula alcalina*	ID	Plant	BS
Primrose, Bering Dwarf	*Douglasia beringensis*	AK	Plant	BS
Primrose, Greenland	*Primula egaliksensis*	CO	Plant	BS
Primrose, House Range	*Primula cusickiana domensis*	UT	Plant	BS
Primrose, Maguire	*Pisidium ultramontanum*	OR	Snail	BS
Primrose, Maguire	*Primula maguirei*	UT	Plant	FT
Primrose, Mealy	*Primula incana*	MT	Plant	BS
Princesplume, Malheur (Oregon Princesplume; Perenial Princesplume)	*Stanleya confertiflora*	ID, OR	Plant	BS
Pronghorn, Sonoran	*Antilocapra americana sonoriensis*	AZ	Mammal	FE
Pseudoscorpion, Malheur	*Apochthonius malheuri*	OR	Arachnid	BS
Pupfish, Amargosa River	*Cyprinodon nevadensis amargosae*	CA	Fish	BS
Pupfish, Ash Meadows Amargosa	*Cyprinodon nevadensis mionectes*	NV	Fish	FE
Pupfish, Desert	*Cyprinodon macularius*	AZ, CA	Fish	FE
Pupfish, Devil's Hole	*Cyprinodon diabolis*	NV	Fish	FE
Pupfish, Owens	*Cyprinodon radiosus*	CA	Fish	FE
Pupfish, Pecos	*Cyprinodon pecosensis*	NM	Fish	C
Pupfish, Warm Springs	*Cyprinodon nevadensis pectoralis*	NV	Fish	FE
Pupfish, White Sands	*Cyprinodon tularosa*	NM	Fish	BS
Purpusia, Rock	*Ivesia arizonica saxosa*	NV	Plant	BS
Pussytoes, Meadows	*Antennaria arcuata*	NV, WY	Plant	BS
Pygmy-owl, Cactus Ferruginous	*Glaucidium brasilianum cactorum*	AZ	Bird	FE
Pygmy-owl, Northern (Blue Mountains Pygmy-owl)	*Glaucidium gnoma*	ID	Bird	W
Pygmy-owl, Northern (Blue Mountains Pygmy-owl)	*Glaucidium gnoma*	OR	Bird	BS
Pygmy Poppy, White	*Canbya candida*	CA	Plant	BS
Pyrg, Bifid Duct	*Pyrgulopsis peculariaris*	NV	Snail	BS
Pyrg, Big Warm Spring	*Pyrgulopsis papillata*	NV	Snail	BS
Pyrg, Carinate Duckwater	*Pyrgulopsis carinata*	NV	Snail	BS
Pyrg, Chupadera	*Pyrgulopsis chupaderae*	NM	Crustacean	C
Pyrg, Dixie Valley	*Pyrgulopsis dixensis*	NV	Snail	BS
Pyrg, Duckwater	*Pyrgulopsis aloba*	NV	Snail	BS
Pyrg, Elongate Cain Spring	*Pyrgulopsis augusta*	NV	Snail	BS
Pyrg, Elongate Mud Meadows	*Pyrgulopsis notidicola*	NV	Snail	BS
Pyrg, Fly Ranch	*Pyrgulopsis bruesi*	NV	Snail	BS
Pyrg, Gila	*Pyrgulopsis gilae*	NM	Crustacean	C
Pyrg, Humbolt	*Pyrgulopsis humboldtensis*	NV	Snail	BS
Pyrg, Landyes	*Pyrgulopsis landeyi*	NV	Snail	BS
Pyrg, Large-gland Carico	*Pyrgulopsis basiglans*	NV	Snail	BS

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Pyrg, Northern Soldier Meadow	*Pyrgulopsis militaris*	NV	Snail	BS
Pyrg, Oasis Valley	*Pyrgulopsis micrococcus*	NV	Snail	BS
Pyrg, Ovate Cain Spring	*Pyrgulopsis pictilis*	NV	Snail	BS
Pyrg, Socorro	*Pyrgulopsis neomexicana*	NM	Crustacean	FE
Pyrg, Souther Soldier Meadow	*Pyrgulopsis umbilicata*	NV	Snail	BS
Pyrg, Southern Duckwater	*Pyrgulopsis anatina*	NV	Snail	BS
Pyrg, Southern Steptoe	*Pyrgulopsis sulcata*	NV	Snail	BS
Pyrg, Spring Mountain	*Pyrgulopsis deaconi*	NV	Snail	BS
Pyrg, Squat Mud Meadows	*Pyrgulopsis limaria*	NV	Snail	BS
Pyrg, Sub-glubose Steptoe Ranch	*Pyrgulopsis orbiculata*	NV	Snail	BS
Pyrg, Transverse Gland	*Pyrgulopsis cruciglans*	NV	Snail	BS
Pyrg, Wongs	*Pyrgulopsis wongi*	NV	Snail	BS
Quail, Mountain	*Oreortyx pictus*	ID, NV	Bird	BS
Queen-of-the-forest	*Filipendula occidentalis*	OR	Plant	BS
Rabbit, Pygmy	*Brachylagus idahoensis*	CA, ID, MT, NV, UT, WY	Mammal	BS
Rabbit, Pygmy (Columbia Basin Distinct Population Segment)	*Brachylagus idahoensis*	OR	Mammal	FE
Rabbit, Pygmy (EmE = Washington; PE = Washington)	*Brachylagus idahoensis*	OR	Mammal	BS
Rabbitbrush, Guadalupe	*Chrysothamnus nauseosus texensis*	NM	Plant	BS
Rabbitbrush, Remote (Pintwater Rabbitbrush)	*Chrysothamnus eremobius*	NV	Plant	BS
Ragwort, Cut-leaved	*Senecio eurycephalus lewisrosei*	CA	Plant	BS
Ragwort, Few Flowered	*Packera pauciflora*	CO	Plant	BS
Ragwort, Red Hills	*Packera clevelandii*	CA	Plant	BS
Ragwort, Western	*Senecio hesperius*	OR	Plant	BS
Rail, Yellow	*Coturnicops noveboracensis*	OR	Bird	BS
Rail, Yuma Clapper	*Rallus longirostris yumanensis*	AZ, CA, NV	Bird	FE
Raillardella, Muir's	*Raillardiopsis muirii*	CA	Plant	BS
Raillardella, Showy	*Raillardella pringlei*	CA	Plant	BS
Ramshorn (Snail), Great Basin	*Helisoma (Carinifex) newberryi newberryi*	OR	Snail	BS
Ramshorn, Borax Lake	*Planorbella oregonensis*	NM, OR	Snail	BS
Raspberry, Northwest	*Rubus nigerrimus*	OR	Plant	BS
Rat, Chisel-toothed Kangaroo	*Dipodomys microps celsus*	UT	Mammal	BS
Rat, Desert Kangaroo	*Dipodomys deserti*	UT	Mammal	BS
Rat, Fresno Kangaroo	*Dipodomys heermani exilis*	CA	Mammal	FE
Rat, Giant Kangaroo	*Dipodomys ingens*	CA	Mammal	FE
Rat, House Rock Valley Chisel-toothed Kangaroo	*Dipodomys microps leucotis*	AZ	Mammal	BS
Rat, Marysville Kangaroo	*Dipodomys californicus eximius*	CA	Mammal	BS
Rat, Merriam's Kangaroo	*Dipodomys merriami*	UT	Mammal	BS
Rat, Morro Bay Kangaroo	*Dipodomys heermani morroensis*	CA	Mammal	FE
Rat, Short-nosed Kangaroo	*Dipodomys nitratoides brevinasus*	CA, WY	Mammal	BS
Rat, Stephen's Kangaroo	*Dipodomys stephensi*	CA, UT	Mammal	FE
Rat, Tipton Kangaroo	*Dipodomys nitratoides nitratoides*	CA	Mammal	FE
Rattlesnake, Midget Faded	*Crotalus viridis concolor*	CO, WY	Reptile	BS
Rattlesnake, Mojave	*Crotalus scutulatus scutulatus*	UT	Reptile	BS
Rattlesnake, New Mexican Ridge-nosed	*Crotalus willardi obscurus*	AZ, NM	Reptile	FT

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Rattlesnake, Southwestern Speckled	*Crotalus mitchellii pyrrhus*	UT	Reptile	BS
Rattleweed, San Diego	*Astragalus oocarpus*	CA	Plant	BS
Reedgrass, Cascade	*Calamagrostis tweedyi*	ID	Plant	BS
Reed-mustard, Barneby	*Schoenocrambe barnebyi*	UT	Plant	FE
Reed-mustard, Clay	*Schoenocrambe argillacea*	UT	Plant	FT
Reed-mustard, Shrubby	*Schoenocrambe suffrutescens*	UT	Plant	FE
Ricegrass, Henderson's	*Achnatherum hendersonii*	OR	Plant	BS
Ricegrass, Little	*Oryzopsis exigua*	CA	Plant	BS
Ricegrass, Small-flowered	*Oryzopsis micranthum*	ID	Plant	BS
Ricegrass, Wallowa	*Achnatherum wallowensis*	OR	Plant	BS
Ringtail	*Bassariscus astutus*	NM, UT	Mammal	BS
Roach, Red Hills	*Lavinia symmetricus* ssp.	CA	Fish	BS
Rock-brake, Slender	*Cryptogramma stelleri*	CO	Plant	BS
Rockcress, Bodie Hills	*Arabis bodiensis*	CA, NV	Plant	BS
Rockcress, Crandall	*Arabis crandallii*	CO	Plant	BS
Rockcress, Crater Lake	*Arabis suffrutescens horizontalis*	OR	Plant	BS
Rockcress, Daggett	*Arabis demissa languida*	MT	Plant	BS
Rockcress, Elko	*Arabis falcifructa*	NV	Plant	BS
Rockcress, Grouse Creek	*Arabis falcatoria*	NV	Plant	BS
Rockcress, Hell's Canyon	*Arabis hastatula*	OR	Plant	BS
Rockcress, Koehler's	*Arabis koehleri koehleri*	OR	Plant	BS
Rock-cress, McDonalds	*Arabis macdonaldiana*	CA	Plant	FE
Rockcress, Ophir Pass	*Arabis ophira*	NV	Plant	BS
Rockcress, Park	*Arabis fernaldiana fernaldiana*	CO, UT	Plant	BS
Rockcress, Sapphire	*Arabis fecunda*	MT	Plant	BS
Rockcress, Small	*Arabis pusilla*	WY	Plant	BS
Rock-daisy, Alcove	*Perityle specuicola*	UT	Plant	BS
Rock-daisy, Black	*Townsendia smithii*	AZ	Plant	BS
Rock-daisy, Clifton	*Perityle ambrosiifolia*	AZ	Plant	BS
Rock-daisy, Hanapah	*Perityle villosa*	CA	Plant	BS
Rock-daisy, Nodding	*Perityle cernua*	NM	Plant	BS
Rockmat, Chelan	*Petrophyton cinerascens*	OR	Plant	BS
Rockress, Kass	*Draba kassii*	UT	Plant	BS
Rock-rose, Diablo	*Helianthella castanea*	CA	Plant	BS
Rock-tansey	*Sphaeromeria capitata*	CO	Plant	BS
Rose, Grand Canyon	*Rosa stellata abyssa*	AZ	Plant	BS
Rosewood, Arizona Sonoran	*Vauquelinia californica sonorensis*	AZ	Plant	BS
Rosewood, Limestone	*Vauquelinia californica pauciflora*	NM	Plant	BS
Rubberweed, Cooper's	*Hymenoxys cooperi canescens*	ID	Plant	BS
Rubberweed, Stone	*Hymenoxys lapidicola*	UT	Plant	BS
Rupertia, Hall's	*Rupertia hallii*	CA	Plant	BS
Rush, Kellogg's	*Juncus kelloggii*	OR	Plant	BS
Rush, Red Bluff Dwarf	*Juncus leiospermus leiospermus*	CA	Plant	BS
Rush, Tiehm's	*Juncus tiehmii*	OR	Plant	BS
Rush-lily, Purple-flowered	*Hastingsia atropurpurea*	OR	Plant	BS
Sage, Aravaipa	*Salvia amissa*	AZ	Plant	BS
Sage, Chicken	*Sphaeromeria argentea*	MT	Plant	BS
Sage, Clokey Mountain (Clokey Purple Sage)	*Salvia dorrii* var *clokeyi*	NV	Plant	BS
Sagebrush, Laramie False	*Sphaeromeria simplex*	WY	Plant	BS
Sagebrush, Porter's	*Artemisia porteri*	WY	Plant	BS

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Sage-grouse, Greater	*Centrocercus urophasianus*	CA, CO, ID, MT, NV, OR, UT, WY	Bird	BS
Sage-grouse, Gunnison	*Centrocercus minimus*	CO, UT	Bird	C
Salamander, California Tiger	*Ambystoma californiense*	CA	Amphibian	FT
Salamander, Coeur d'Alene	*Plethodon idahoensis*	ID	Amphibian	BS
Salamander, Columbia Torrent	*Rhyacotriton kezeri*	OR	Amphibian	BS
Salamander, Desert Slender	*Batrachoseps aridus*	CA	Amphibian	FE
Salamander, Idaho Giant	*Dicamptodon aterrimus*	ID	Amphibian	BS
Salamander, Inyo Mountains Slender	*Batrachoseps campi*	CA	Amphibian	BS
Salamander, Oregon Slender	*Batrachoseps wrighti*	OR	Amphibian	BS
Salamander, Sonora Tiger	*Ambystoma tigrinum stebbinsi*	AZ	Amphibian	FE
Salamander, Tehachapi Slender	*Batrachoseps stebbinsi*	CA	Amphibian	BS
Salamander, Yellow-blotched	*Ensatina eschscholtzi croceator*	CA	Amphibian	BS
Salmon, Beaver Creek chinook	*Onconhynchus tshawytscha*	AK	Fish	BS
Salmon, Chinook (California Coastal ESU[2])	*Oncorhynchus tshawytscha*	CA	Fish	FT
Salmon, Chinook (Central Valley ESU)	*Oncorhynchus tshawytscha*	CA, ID	Fish	C
Salmon, Chinook (Fall Lower Columbia River ESU)	*Oncorhynchus tshawytscha*	OR	Fish	FT
Salmon, Chinook (Fall Snake River Run ESU)	*Oncorhynchus tshawytscha*	ID, OR	Fish	FT
Salmon, Chinook (Lower Columbia River ESU)	*Oncorhynchus tshawytscha*	OR	Fish	FT
Salmon, Chinook (Spring Central Valley Run ESU)	*Oncorhynchus tshawytscha*	CA	Fish	FT
Salmon, Chinook (Spring/summer Snake River ESU)	*Oncorhynchus tshawytscha*	ID, OR	Fish	FT
Salmon, Chinook (Upper Columbia River Spring Run ESU)	*Oncorhynchus tshawytscha*	OR	Fish	FT
Salmon, Chinook (Upper Willamette ESU)	*Oncorhynchus tshawytscha*	OR	Fish	FT
Salmon, Chinook (Winter Sacramento River Run ESU)	*Oncorhynchus tshawytscha*	CA, OR	Fish	FE
Salmon, Chum	*Oncorhynchus keta*	OR	Fish	BS
Salmon, Chum (Columbia River ESU)	*Oncorhynchus keta*	OR	Fish	FT
Salmon, Clear Creek Chum	*Onocnhynchus keta*	AK	Fish	BS
Salmon, Coho (Central California Coast ESU)	*Oncorhynchus kisutch*	CA, OR	Fish	FT
Salmon, Coho (Lower Columbia River / Southwest Washington ESU)	*Oncorhynchus kisutch*	OR	Fish	C
Salmon, Coho (Lower Columbia River / Southwest Washington ESU)	*Onchorynchus kisutch*	OR	Fish	C
Salmon, Coho (Oregon Coast ESU)	*Oncorhynchus kisutch*	OR	Fish	FT
Salmon, Coho (Oregon/California Coast ESU)	*Oncorhynchus kisutch*	CA, OR	Fish	FT
Salmon, Fall Chinook	*Oncorhynchus tshawytscha*	OR	Fish	FT
Salmon, Sockeye (Snake River, Idaho Stock ESU)	*Oncorhynchus nerka*	OR, ID	Fish	FE
Saltbush, Giant Four-wing	*Atriplex canescens gigantea*	UT	Plant	BS

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Saltbush, Griffith's	*Atriplex griffithsii*	NM	Plant	BS
Saltbush, Heart-leaved	*Atriplex cordulata*	CA	Plant	BS
Saltbush, Lost Hills	*Atriplex vallicola*	CA	Plant	BS
Sand-food	*Pholisma sonorae*	AZ	Plant	BS
Sand-food, Blue	*Triteleiopsis palmeri*	AZ	Plant	BS
Sand-food, Scaly	*Pholisma arenarium*	AZ	Plant	BS
Sandpaper-plant	*Petalonyx parryi*	UT	Plant	BS
Sandpaper-plant, Death Valley	*Petalonyx thurberi gilmanii*	CA	Plant	BS
Sandpiper, Buff-breasted	*Tryngites subruficollis*	AK	Bird	BS
Sandpiper, Upland	*Bartramia longicauda*	ID, OR	Bird	BS
Sand-verbena, Pink	*Abronia umbellata breviflora*	CA	Plant	BS
Sandwort, Howell's	*Minuartia howellii*	CA	Plant	BS
Sandwort, Marsh	*Arenaria paludicola*	OR	Plant	FE
Sandwort, Nuttall	*Minuartia nuttallii*	CO	Plant	BS
Sandwort, Scott Mountain	*Minuartia stolonifera*	CA	Plant	BS
Sapsucker, Red-naped	*Sphyrapicus nuchalis*	ID	Bird	W
Sapsucker, Red-naped	*Sphyrapicus nuchalis*	NV	Bird	BS
Sapsucker, Williamson's	*Sphyrapicus thryoideus*	ID, UT	Bird	BS
Sauger	*Stizostedion canadense*	MT	Fish	BS
Saw-wort, Weber	*Saussurea weberi*	CO	Plant	BS
Saxifrage, Aleutian	*Saxifraga aleutica*	AK	Plant	BS
Scalebroom, Gypsum	*Lepidospartum burgessii*	NM	Plant	BS
Scarab, Aegialian Beetle	*Aegialia knighti*	NV	Insect	BS
Scarab, Big Dune Aphodius	*Aphodius* sp.	NV	Insect	BS
Scarab, Crescent Dune Aegialian	*Aegialia crescenta*	NV	Insect	BS
Scarab, Crescent Dune Aphodius	*Aphodius* sp.	NV	Insect	BS
Scarab, Crescent Dune Serican	*Serica ammomensico*	NV	Insect	BS
Scarab, Guiliani's Dune	*Pseudocotalpa guilianii*	NV	Insect	BS
Scarab, Hardy's Aegialian	*Aegialia hardyi*	NV	Insect	BS
Scarab, Humboltd Serican	*Serica humboldti*	NV	Insect	BS
Scarab, Sand Mountain Aphodius	*Aphodius* sp.	NV	Insect	BS
Scarab, Sand Mountain Serican	*Serica psamnobunus*	NV	Insect	BS
Scorpion Plant, Beatley	*Phacelia beatleyae*	NV	Plant	BS
Scoter, Black	*Melanitta nigra*	AK	Bird	BS
Scoter, Surf	*Melanitta perspicillata*	AK	Bird	BS
Sculpin, Bear Lake	*Cottus extensus*	ID	Fish	BS
Sculpin, Malheur Mottled	*Cottus bendirei*	OR	Fish	BS
Sculpin, Shorthead	*Cottus confusus*	ID	Fish	W
Sculpin, Shoshone	*Cottus greenei*	ID	Fish	BS
Sculpin, Torrent	*Cottus rohtheus*	ID	Fish	W
Sculpin, Wood River	*Cottus leiopomus*	ID	Fish	BS
Scurfpea, Three-nerved	*Pediomelum trinervatum*	AZ	Plant	BS
Sea turtle, Leatherback	*Dermochelys coriacea*	AK	Reptile	FE
Seal, Harbor	*Phoca vitulina concolor*	AK	Mammal	BS
Sea-lion, Steller	*Eumetopias jubatus*	AK (West of Cape Suckling), CA, OR	Mammal	FE
Sea-lion, Steller	*Eumetopias jubatus*	AK (East of Cape Suckling)	Mammal	FT

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Sedge, Bristly	*Carex comosa*	ID	Plant	BS
Sedge, Canadian Single Spike	*Carex scirpoidea*	CO	Plant	BS
Sedge, Craw's	*Carex crawei*	MT	Plant	BS
Sedge, Foothill	*Carex tumulicola*	ID	Plant	BS
Sedge, Giant	*Carex spissa*	AZ	Plant	BS
Sedge, Green	*Carex viridula*	CO	Plant	BS
Sedge, Idaho	*Carex idahoa*	ID, MT, OR	Plant	BS
Sedge, Indian Valley	*Carex arboriginum*	ID	Plant	BS
Sedge, Livid	*Carex livida*	CO, ID	Plant	BS
Sedge, Low Northern	*Carex concinna*	CO	Plant	BS
Sedge, Navajo	*Carex specuicola*	AZ, UT	Plant	FT
Sedge, San Luis Obispo	*Carex obispoensis*	CA	Plant	BS
Sedge, Unnamed	*Carex nov*	OR	Plant	BS
Sedge, Western	*Carex occidentalis*	ID	Plant	BS
Sedge, Yellow	*Carex flava*	CO	Plant	BS
Sheep, Bighorn (Peninsular Ranges Bighorn Sheep)	*Ovis canadensis*	CA	Mammal	FE
Sheep, California Bighorn (Sierra Nevada Bighorn Sheep)	*Ovis canadensis californiana*	CA, ID	Mammal	FE
Sheep, Desert Bighorn	*Ovis canadensis nelsoni*	CA, NV	Mammal	BS
Shield-fern, Aleutian	*Polysticum aleuticum*	AK	Plant	FE
Shiner, Arkansas River	*Notropis girardi*	NM	Fish	FT
Shiner, Beautiful	*Cyprinella formosa*	AZ, NM	Fish	FT
Shiner, Pecos Bluntnose	*Notropis simus pecosensis*	NM	Fish	FT
Shiner, Rio Grande	*Notropis jemezanus*	NM	Fish	BS
Shiner, River	*Notropis blennius*	CO	Fish	BS
Shootingstar, Frigid	*Dodecatheon austrofrigidum*	OR	Plant	BS
Shoshonea	*Shoshonea pulvinata*	MT, WY	Plant	BS
Shoulderband (Snail), Oregon	*Helminthoglypta hertleini*	OR	Snail	BS
Shrew, Arizona	*Sorex arizonae*	NM	Mammal	BS
Shrew, Buena Vista Lake Ornate	*Sorex ornatus relictus*	CA	Mammal	FE
Shrew, Dwarf	*Sorex nanus*	UT, WY	Mammal	BS
Shrew, Merriam's	*Sorex merriami*	MT	Mammal	BS
Shrew, Preble's	*Sorex preblei*	MT, NV	Mammal	BS
Shrike, Loggerhead	*Lanius ludovicianus*	AZ, ID, MT, NM, NV, WY	Bird	BS
Shrimp, Vernal Pool Tadpole	*Lepidurus packardi*	CA	Crustacean	FE
Sidalcea, Maple-leaved	*Sidalcea malachroides*	CA, OR	Plant	BS
Sideband (Snail), Columbia	*Monadenia fidelis columbiana*	OR	Snail	BS
Sideband (Snail), Green	*Monadenia fidelis beryllica*	OR	Snail	BS
Sideband (Snail), Hairy Sierra	*Monadenia mormonum hirsuta*	CA	Snail	BS
Sideband (Snail), Keeled	*Monadenia circumcarinata*	CA	Snail	BS
Sideband (Snail), Modoc	*Monadenia* sp.	OR	Snail	BS
Sideband (Snail), Oregon/Dalles	*Monadenia fidelis minor*	OR	Snail	BS
Sideband (Snail), Travelling	*Monadenia fidelis celeuthia*	OR	Snail	BS
Sidewinder, Mojave Desert	*Crotalus cerastes cerastes*	UT	Reptile	BS
Silene, Seely's	*Silene seelyi*	OR	Plant	BS
Silverpuffs, Howell's	*Microseris howellii*	OR	Plant	BS
Skeletonweed, Dolores River	*Lygodesmia doloresensis*	CO, UT	Plant	BS
Skeletonweed, Rush Pink	*Lygodesmia entrada*	UT	Plant	BS
Skeletonweed, Thorn	*Stephanomeria spinosa*	MT	Plant	BS

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Skink, Arizona	*Eumeces gilberti arizonensis*	AZ	Reptile	BS
Skink, Coronado	*Eumeces skiltonianus interparietalis*	CA	Reptile	BS
Skink, Many-lined	*Eumeces multivirgatus gaigeae*	UT	Reptile	BS
Skink, Western Red-tailed	*Eumeces gilberti rubricaudatus*	NV	Reptile	BS
Skipper, Ash Meadows Alkali	*Pseudocopaeodes eunus alinea*	NV	Insect	BS
Skipper, Carson Wandering	*Pseudocopaeodes eunus obscurus*	CA, NV	Insect	FE
Skipper, Dakota	*Hesperia dacotae*	MT	Insect	C
Skipper, Denio Sandhill	*Polites sabuleti sinemaculata*	NV	Insect	BS
Skipper, MacNeil Sootywing	*Hesperopsis gracielae*	AZ, NV	Insect	BS
Skipper, Mardon	*Polites mardon*	CA, NM, OR	Insect	C
Skipper, Mono Basin	*Hesperia uncas giulianii*	NV	Insect	BS
Skipper, Pawnee Montane	*Hesperia leonardus maontana*	CO	Insect	FT
Skipper, Railroad Valley	*Hesperia uncas fulvapalla*	NV	Insect	BS
Skipper, White Mountain	*Hesperia miriamae longaevicola*	NV	Insect	BS
Skipper, White River Valley	*Hesperia uncas grandiosa*	NV	Insect	BS
Skullcap, Dwarf	*Scutellaria nana nana*	CA	Plant	BS
Skunk, Spotted	*Spilogale putorius*	MT	Mammal	BS
Smooth-aster, Guadalupe	*Symphyotrichum geyeri*	NM	Plant	BS
Smooth-aster, Jessica's	*Symphyotrichum jessicae*	ID, OR	Plant	BS
Smooth-aster, Rush	*Symphyotrichum boreale*	ID, OR	Plant	BS
Snail, Bliss Rapids	*Taylorconcha serpenticola*	ID	Snail	FT
Snail, Bruneau Hot Springs	*Pyrgulopsis bruneauensis*	ID, MT, WY	Snail	FE
Snail, Disc (Oregonian Snail)	*Cryptomastix* sp.	OR	Snail	BS
Snail, Dona Ana Talus	*Sonorella todseni*	NM	Snail	BS
Snail, Hells Canyon Land	*Cryptomastix populi*	OR	Snail	BS
Snail, Idaho Spring	*Pyrgulopsis idahoenis*	ID	Snail	FE
Snail, Koster's Tryonia	*Tryonia kosteri*	NV	Snail	C
Snail, Mission Creek (Oregonian Snail)	*Cryptomastix magnidentata*	ID	Snail	BS
Snail, Morro Shoulderband	*Helminthoglypta walkeriana*	CA	Snail	FE
Snail, Mountain Boulder Pile	*Oreohlix jugalis*	ID	Snail	BS
Snail, Mountain Idaho Banded	*Orehelix idahoensis idahoensis*	ID	Snail	BS
Snail, Mountain Lava Rock	*Orhelix waltoni*	ID	Snail	BS
Snail, Mountain Whorled	*Orehelix vortex*	ID	Snail	BS
Snail, Newcomb's Littorine	*Algamorda subrotundata*	OR	Snail	BS
Snail, Pecos Assiminea	*Assiminea pecos*	NM	Snail	PE
Snail, Schell Creek Mountain	*Oreohelix nevadensis*	NV	Snail	BS
Snail, Snake River Physa	*Physa natricina*	ID	Snail	FE
Snail, Striate Mountain	*Orehelix strigosa goniogyra*	ID	Snail	BS
Snail, Utah Valvata	*Valvata utahensis*	ID, UT	Snail	FE
Snails, Hydrobiid Spring	All species in genus *Pyrgulopsis*	AZ	Snail	BS
Snails, Hydrobiid Spring	All species in genus *Pyrgulopsis*	OR	Snail	BS
Snails, Succineid	All species in family Succineidae	AZ	Snail	BS
Snake, Common Garter	*Thamnophis sirtalis*	ID	Reptile	BS
Snake, Giant Garter	*Thamnophis gigas*	CA	Reptile	FT
Snake, Great Plains Rat	*Elaphe guttata emoryi*	UT	Reptile	BS
Snake, Longnose	*Rhinocheilus lecontei*	ID	Reptile	BS
Snake, Mexican Garter	*Thamnophis eques megalops*	NM	Reptile	BS
Snake, Milk	*Lampropeltis triangulum taylori*	CO, UT	Reptile	BS
Snake, Mojave Patch-nosed	*Salvadora hexalepis mojavensis*	UT	Reptile	BS
Snake, Narrowhead Garter	*Thamnophis rufipunctatus*	NM	Reptile	BS

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Snake, Night	*Hypsiglena torquata*	ID	Reptile	W
Snake, Painted Desert Glossy	*Arizona elegans philipi*	UT	Reptile	BS
Snake, Ringneck	*Diadophis punctatus*	ID	Reptile	W
Snake, Sanora Lyre	*Trimorphodon biscutatus lambda*	UT	Reptile	BS
Snake, Smooth Green	*Opheodrys vernalis*	UT	Reptile	BS
Snake, Two-striped Garter	*Thamnophis hammondii*	CA	Reptile	BS
Snake, Utah Blind	*Leptotyphlops humilis utahensis*	UT	Reptile	BS
Snake, Western Ground	*Sonora semiannulata*	ID	Reptile	BS
Snow-wreath, Shasta	*Neviusia cliftonii*	CA	Plant	BS
Soaproot, Dwarf	*Chlorogalum pomeridianum minus*	CA	Plant	BS
Soaproot, Red Hills	*Chlorogalum grandiflorum*	CA	Plant	BS
Spadefoot, Great Basin	*Spea intermontana*	CO, WY	Amphibian	BS
Sparrow, Baird's	*Ammodramus bairdii*	MT, NM, WY	Bird	BS
Sparrow, Black-throated	*Amphispiza bilineata*	ID	Bird	BS
Sparrow, Brewer's	*Spizella breweri*	ID, WY	Bird	BS
Sparrow, Grasshopper	*Ammodramus savannarum*	ID	Bird	W
Sparrow, Grasshopper	*Ammodramus savannarum*	UT	Bird	BS
Sparrow, Large-billed Savannah	*Passerculus sandwichensis rostratus*	AZ	Bird	BS
Sparrow, LeConte's	*Ammodramus leconteii*	MT	Bird	BS
Sparrow, Sage	*Amphispiza belli*	ID, MT, OR, WY	Bird	BS
Sparrow, Vesper (Oregon Sparrow)	*Pooecetes gramineus affinis*	NV, OR	Bird	BS
Spider-flower, Many Stemmed	*Cleome multicaulis*	CO, WY, NM	Plant	BS
Spikedace	*Meda fulgida*	AZ, NM	Fish	FT
Spinedace, Big Spring	*Lepidomeda mollispinis pratensis*	NV	Fish	FT
Spinedace, Little Colorado	*Lepidomeda vittata*	AZ	Fish	FT
Spinedace, Virgin River	*Lepidomeda mollispinis mollispinis*	NV, UT	Fish	BS
Spinedace, White River	*Lepidomeda albivalis*	NV	Fish	FE
Spineflower, Brewer's	*Chorizanthe breweri*	CA	Plant	BS
Spineflower, Indian Valley	*Aristocapsa insignis*	CA	Plant	BS
Spineflower, Monterey	*Chorizanthe pungens pungens*	CA, CO	Plant	FT
Spineflower, Orcutt's	*Chorizanthe orcuttiana*	CA	Plant	FE
Spineflower, San Benito	*Chorizanthe biloba immemora*	CA	Plant	BS
Spineflower, Slender-horned	*Dodecahema leptoceras*	CA	Plant	FE
Spineflower, Straight-awned	*Chorizanthe rectispina*	CA	Plant	BS
Spleenwort, Dalhouse	*Asplenium [=Ceterach] dalhousiae*	AZ	Plant	BS
Splittail, Sacramento	*Pogonichthys macrolepidotus*	CA	Fish	FT
Springbeauty, Ogilvie Mountains	*Claytonia ogilviensis*	AK	Plant	BS
Springfish, Hiko White River	*Crenichthys baileyi grandis*	NV	Fish	FE
Springfish, Moapa White River	*Crenichthys baileyi moapae*	NV	Fish	BS
Springfish, Moorman White River	*Crenichthys baileyi thermophilus*	NV	Fish	BS
Springfish, Preston White River	*Crenichthys baileyi albivallis*	NV	Fish	BS
Springfish, Railroad Valley	*Crenichthys nevadae*	NV	Fish	FT
Springfish, White River	*Crenichthys baileyi baileyi*	NV	Fish	FE
Spring-parsley, Featherleaf	*Cymopterus beckii*	UT	Plant	BS
Spring-parsley, Plains	*Cymopterus acaulis parvus*	UT	Plant	BS
Spring-parsley, Uinta Basin	*Cymopterus duchesnesis*	CO	Plant	BS
Springsnail, Crooked Creek	*Pyrgulopsis intermedia*	OR	Snail	BS
Springsnail, Harney Lake	*Pyrgulopsis hendersoni*	OR	Snail	BS
Springsnail, Idaho	*Fontelicella idahoensis*	ID	Snail	FE
Springsnail, Malheur Cave	*Oncopodura mala*	CA, OR	Snail	BS

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Springsnail, Owyhee Hot	*Pyrgulopsis* sp.	OR	Snail	BS
Springsnail, Roswell	*Pyrgulopsis roswellensis*	NM	Snail	PE
Spruce, White	*Picea glauca*	ID	Plant	BS
Spurge, Flat-seeded	*Chamaesyce platysperma*	CA	Plant	BS
Spurge, Hoover's	*Chamaesyce hooveri*	CA	Plant	FT
Spurge, Paria	*Euphorbia nephradenia*	UT	Plant	BS
Spurge, Stony Creek	*Chamaesyce ocellata rattanii*	CA	Plant	BS
Squirrel, Coachella Valley Round-tailed Ground	*Spermophilus tereticaudus chlorus*	CA	Mammal	C
Squirrel, Ground Piaute	*Spermophilus mollis artemisae*	ID	Mammal	BS
Squirrel, Miriam's Ground	*Spermophilus canus vigilis*	ID	Mammal	BS
Squirrel, Northern Idaho Ground	*Spermophilus brunneus brunneus*	ID	Mammal	FT
Squirrel, Rock	*Spermophilus variegatus*	ID	Mammal	W
Squirrel, Southern Idaho Ground	*Spermophilus brunneus*	ID	Mammal	C
Squirrel, Washington Ground	*Spermophilus washingtoni*	OR	Mammal	C
Squirrel, Wyoming Ground	*Spermophilus elegans nevadensis*	ID	Mammal	BS
St. John's-wort, Large Canadian	*Hypericum majus*	ID	Plant	BS
Star-tulip, Long-haired	*Calochortus longebarbatus longebarb*	CA, OR	Plant	BS
Star-tulip, Shirley Meadows	*Calochortus westonii*	CA	Plant	BS
Steelhead (Central California Coast)	*Oncorhynchus mykiss*	CA	Fish	FT
Steelhead (Central Valley ESU)	*Oncorhynchus mykiss*	CA	Fish	FT
Steelhead (Klamath Mountains ESU)	*Oncorhynchus mykiss*	ID	Fish	C
Steelhead (Lower Columbia River ESU)	*Oncorhynchus mykiss*	OR	Fish	FT
Steelhead (Middle Columbia River ESU)	*Oncorhynchus mykiss*	OR	Fish	FT
Steelhead (Northern California ESU)	*Oncorhynchus mykiss*	CA	Fish	FT
Steelhead (Oregon Coast ESU)	*Oncorhynchus mykiss*	OR	Fish	C
Steelhead (Snake River Basin ESU)	*Oncorhynchus mykiss*	ID, OR	Fish	FT
Steelhead (South-central California Coast ESU)	*Oncorhynchus mykiss*	CA	Fish	FT
Steelhead (Southern California ESU)	*Oncorhynchus mykiss*	CA	Fish	FT
Steelhead (Upper Columbia River ESU)	*Oncorhynchus mykiss*	OR	Fish	FE
Steelhead (Upper Willamette River ESU)	*Oncorhynchus mykiss*	OR	Fish	FT
Steelhead, Gulkana	*Oncorhynchus mykiss*	AK	Fish	BS
Stenotus, Woolly	*Stenotus lanuginosus*	CA	Plant	BS
Stickleaf, Royal Gorge	*Mentzelia densa*	CO	Plant	BS
Stickleaf, Smooth	*Mentzelia mollis*	ID, NV	Plant	BS
Stickleaf, Southwest	*Mentzelia argillosa*	CO	Plant	BS
Stickleback, Unarmored Threespine	*Gasterosteus aculentus williamsonii*	CA	Fish	FE
Stickseed, Cronquist's	*Hackelia cronquistii*	ID	Plant	BS
Stickseed, Deep Creek	*Hackelia ibapensis*	UT	Plant	BS
Stickseed, Rattlesnake	*Hackelia ophiobia*	ID	Plant	BS
Stickseed, Showy	*Hackelia venusta*	OR	Plant	FE
Stickweed, Rocky Mountain	*Cleomella palmeriana*	UT	Plant	BS
Stitchwort, James'	*Pseudostellaria jamesii*	MT	Plant	BS
Stonecat	*Noturus flavus*	CA, CO	Fish	BS
Stonecrop, Applegate	*Sedum oblanceolatum*	OR	Plant	BS
Stonecrop, Bartram	*Graptopetalum bartramii*	AZ	Plant	BS

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Stonecrop, Canyon Creek	*Sedum paradisum*	CA	Plant	BS
Stonecrop, Feather River	*Sedum albomarginatum*	CA	Plant	BS
Stonecrop, Red Mountain	*Sedum eastwoodiae*	CA	Plant	C
Stonecrop, Rogue River	*Sedum moranii*	OR	Plant	BS
Stonefly, Wahkeena Falls Flightless	*Zapada wahkeena*	OR	Insect	BS
Strawberry, Idaho	*Waldsteinia idahoensis*	ID	Plant	BS
Streptanthus, Howell's	*Streptanthus howellii*	OR	Plant	BS
Sturgeon, Pallid	*Scaphirhynchus albus*	CO, MT, WY	Fish	FE
Sturgeon, White	*Acipenser transmontanus*	ID	Fish	BS
Sturgeon, White (Kootenai ESU)	*Acipenser transmontanus*	ID, MT	Fish	FE
Sucker, Blue	*Cycleptus elongatus*	MT, WY	Fish	BS
Sucker, Bluehead	*Catostomus discobolus*	CO, UT, WY	Fish	BS
Sucker, Desert	*Catostomus [=Pantosteus] clarki*	AZ, NM, UT	Fish	BS
Sucker, Flannelmouth	*Catostomus latipinnis*	CO, NV, UT, WY	Fish	BS
Sucker, Goose Lake	*Catostomus occidentalis lacusanserinus*	OR	Fish	BS
Sucker, June	*Chasmistes liorus*	UT	Fish	FE
Sucker, Little Colorado	*Catostomus* sp.	AZ, UT	Fish	BS
Sucker, Lost River	*Deltistes luxatus*	CA, OR	Fish	FE
Sucker, Modoc	*Catostomus mcrops*	CA	Fish	FE
Sucker, Mountain	*Catostomas platyrhynchus*	CO	Fish	BS
Sucker, Razorback	*Xyrauchen texanus*	AZ, CA, CO, NM, NV, UT, WY	Fish	FE
Sucker, Rio Grande	*Catostomus plebeius*	NM	Fish	BS
Sucker, Shortnose	*Chasmistes brevirostris*	CA, OR	Fish	FE
Sucker, Sonora	*Catostomus insignis*	AZ, NM	Fish	BS
Sucker, Wall Canyon	*Catostomus* sp.	NV	Fish	BS
Sucker, Warner	*Catostomus warnerensis*	CA, NV, OR	Fish	FT
Sucker, White River Desert	*Catostomus clarki intermedius*	NV	Fish	BS
Sullivantia, Oregon	*Sullivantia oregana*	OR	Plant	BS
Sullivantia, Wyoming	*Sullivantia hapermanii hapermanii*	MT	Plant	BS
Sumac, Kearney	*Rhus kearneyi kearneyi*	AZ	Plant	BS
Sunburst, Hartweg's Golden	*Pseudobahia bahiifolia*	CA	Plant	FE
Sunburst, San Joaquin Adobe	*Pseudobahia peirsonii*	CA	Plant	FT
Suncup, Diamond Valley	*Camissionia gouldii*	UT	Plant	BS
Sunflower, Pecos	*Helianthus paradoxus*	NM	Plant	FT
Sunray, Ash Meadows	*Enceliopsis nudicaulis corrugata*	NV	Plant	FT
Sunray, Silverleaf	*Enceliopsis argophylla*	AZ, NV	Plant	BS
Swan, Trumpeter	*Cygnus buccinator*	AK, ID, MT, WY	Bird	BS
Swertia, Umpqua	*Frasera umpquaensis*	OR	Plant	BS
Swertia, White River	*Swertia gypsicola*	UT	Plant	BS
Swift, Black	*Cypseloides niger*	ID, UT	Bird	BS
Swift, Vaux's	*Chaetura vauxi*	ID	Bird	W
Tansy-aster, Gypsum Hotsprings	*Machaeranthera gypsitherma*	NM	Plant	BS
Tansymustard, Wyoming	*Descurainia torulosa*	WY	Plant	BS
Tarplant, Congdon's	*Hemizonia parryi congdonii*	CA	Plant	BS
Tarplant, Hall's	*Hemizonia halliana*	CA	Plant	BS
Tarplant, Otay	*Hemizonia conjugens*	CA	Plant	FT
Tarplant, Tecate	*Hemizonia floribunda*	CA	Plant	BS

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Tauschia, Hoover's	*Tauschia hooveri*	OR	Plant	BS
Tern, Black	*Chlidonias niger*	CO, ID, MT, NM, NV, UT	Bird	BS
Tern, Caspian	*Sterna caspia*	UT	Bird	BS
Tern, Least (Interior Tern)	*Sterna antillarum*	CO, MT, NM, WY	Bird	FE
Tetracoccus, Parry's	*Tetracoccus dioicus*	CA	Plant	BS
Thelypody, Arrow	*Thelypodium sagittatum*	MT	Plant	BS
Thelypody, Howell's Spectacular	*Thelypody howellii*	CA	Plant	BS
Thelypody, Northwestern	*Thelypody paniculatum*	MT	Plant	BS
Thelypody, Wavy-leaf	*Thelypodium repandum*	ID	Plant	BS
Thistle, Ashland	*Cirsium ciliolatum*	OR	Plant	BS
Thistle, Cedar Rim	*Cirsium aridum*	WY	Plant	BS
Thistle, Compact Cobwebby	*Cirsium occidentale compactum*	CA	Plant	BS
Thistle, La Graciosa	*Cirsium loncholepis*	CA	Plant	FE
Thislte, Long-styled	*Cirsium longistylum*	MT	Plant	BS
Thistle, Mount Hamilton	*Cirsium fontinale campylon*	CA	Plant	BS
Thistle, Ownbey's	*Cirsium ownbeyi*	CO, UT, WY	Plant	BS
Thistle, Pitcher's	*Cirsium pitcheri*	CA	Plant	FT
Thistle, Rocky Mountain	*Cirsium perplexans*	CO	Plant	BS
Thistle, Slough	*Cirsium crassicaule*	CA, WY	Plant	BS
Thistle, Virgin	*Cirsium virginense*	UT	Plant	BS
Thornbush, Seaside	*Kaemefeltia californica*	CA	Plant	BS
Thorn-mint, San Benito	*Acanthomintha obovata*	CA	Plant	BS
Thorn-mint, San Diego	*Acanthomintha ilicifolia*	CA	Plant	FT
Thorn-mint, San Clara	*Acanthomintha lanceolata*	CA	Plant	BS
Thrasher, Bendire's	*Toxostoma bendirei*	CA	Bird	BS
Thrasher, Crissal	*Toxostoma crissale*	NV, UT	Bird	BS
Thrasher, Le Conte's	*Toxostoma lecontei*	CA, NV	Bird	BS
Thrasher, Sage	*Oreoscoptes montanus*	ID	Bird	W
Thrasher, Sage	*Oreoscoptes montanus*	WY	Bird	BS
Thread moss, Slender	*Orthodontium gracile*	CA	Plant	BS
Threads, Comanche Point Layia	*Layia leucopappa*	CA	Plant	BS
Threadstem, Rigid	*Nemacladus rigidus*	ID, WY	Plant	BS
Three Hearts	*Tricardia watsonii*	AZ	Plant	BS
Thrush, Gray-cheeked	*Catharus mimimus*	AK	Bird	BS
Tidy-tips, Munz's	*Layia munzii*	CA	Plant	BS
Tidy-tips, Rayless	*Layia discoidea*	CA	Plant	BS
Tightcoil (Snail), Crater Lake	*Pristiloma arctium crateris*	OR	Snail	BS
Titmouse, Juniper	*Baelophus griseus*	NV	Bird	BS
Toad, Amargosa	*Bufo nelsoni*	NV	Amphibian	BS
Toad, Arizona	*Bufo microscaphus microscaphus*	CA, NM, UT	Amphibian	BS
Toad, Arroyo	*Bufo microscaphus californicus*	CA	Amphibian	FE
Toad, Boreal	*Bufo boreas boreas*	CO, ID, WY	Amphibian	C
Toad, Canadian	*Bufo hemiophrys*	MT	Amphibian	BS
Toad, Couch's Spadefoot	*Scaphiopus couchi*	CA	Amphibian	BS
Toad, Southwestern	*Bufo microscaphus*	NV	Amphibian	BS
Toad, Western	*Bufo boreas*	ID	Amphibian	BS
Toad, Woodhouse	*Bufo woodhousii*	ID	Amphibian	BS
Toad, Wyoming	*Bufo hemiophyrs baxteri*	WY	Amphibian	FE
Tonestus, Lone Mountain	*Tonestus graniticus*	NV	Plant	BS

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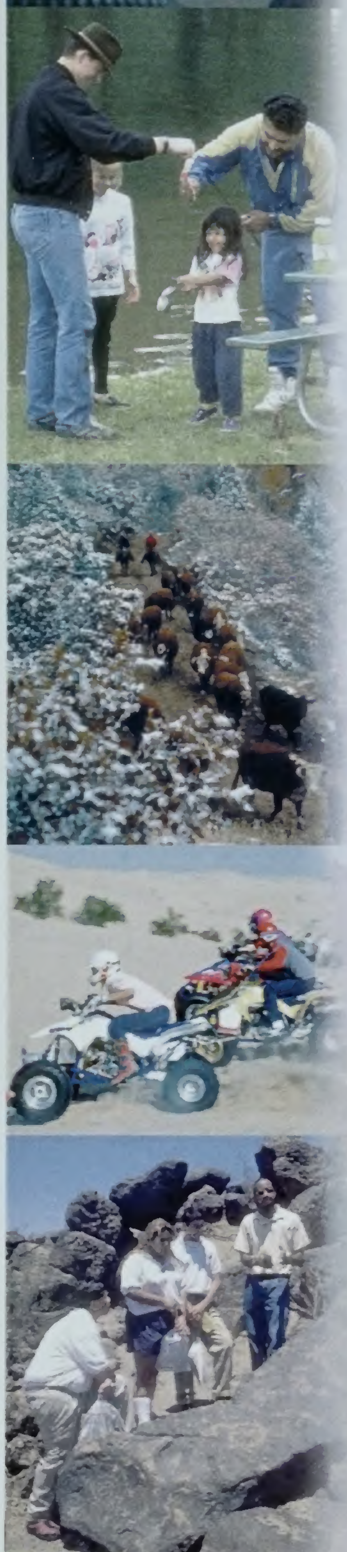
Tortula moss, California	*Tortula californica*	CA	Plant	BS
Topminnow, Gila (including Yaqui)	*Poeciliopsis occidentalis*	AZ, NM	Fish	FE
Topminnow, Plains	*Fundulus sciadicus*	CO	Fish	BS
Tortoise, Desert (Mojave Desert Tortoise)	*Gopherus agassizii*	AZ, CA, NV, UT	Reptile	FT
Towhee, Green-tailed	*Pipilo chlorurus*	ID	Bird	W
Towhee, Inyo California (Brown Towhee)	*Pipilo crissalis eremophilus*	CA	Bird	FT
Townsend-daisy, Cushion	*Townsendia condensata*	MT	Plant	BS
Townsend-daisy, Gypsum	*Townsendia gypsophila*	NM	Plant	BS
Townsend-daisy, Scapose	*Townsendia scapigera*	ID	Plant	BS
Townsend-daisy, Showy	*Townsendia florifera*	MT	Plant	BS
Townsendia, Last Chance	*Townsendia aprica*	UT	Plant	FT
Treefrog, Canyon	*Hyla arenicolor*	CO, WY	Amphibian	BS
Triquetrella moss, California	*Triquetrella californica*	OR	Plant	BS
Triteleia, Leach's	*Triteleia hendersonii leachiae*	OR	Plant	BS
Trout, Bonneville Cutthroat	*Oncorhynchus clarki utah*	ID, NV, UT, WY	Fish	BS
Trout, Bull	*Salvelinus confluentus*	ID, MT, NV, OR	Fish	FT
Trout, Coastal Cutthroat (Columbia River Trout)	*Oncorhynchus clarki clarki*	OR	Fish	BS
Trout, Colorado River Cutthroat	*Oncorhynchus clarki pleuriticus*	CO, UT, WY	Fish	BS
Trout, Fine-spotted Snake River Cutthroat	*Oncorhynchus clarki* spp.	WY	Fish	BS
Trout, Gila	*Oncorhynchus gilae*	AZ, NM	Fish	FE
Trout, Great Basin Redband	*Oncorhynchus mykiss*	OR	Fish	BS
Trout, Greenback Cutthroat	*Oncorhynchus clarki stomias*	CO	Fish	FT
Trout, Inland Redband (Jenny Creek Trout)	*Oncorhynchus mykiss gairdneri*	NV, OR	Fish	BS
Trout, Lahontan Cutthroat	*Oncorhynchus clarki henshawi*	CA, CO, NV, OR, UT	Fish	FT
Trout, Redband	*Oncorhynchus mykiss gibbsi*	ID	Fish	BS
Trout, Rio Grande Cutthroat	*Oncorhynchus clarki virginalis*	CO	Fish	BS
Trout, Westslope Cutthroat	*Oncorhynchus clarki lewisi*	ID, MT	Fish	BS
Trout, Westslope Cutthroat	*Oncorhynchus clarki lewisi*	OR	Fish	BS
Trout, Yellowstone Cutthroat	*Oncorhynchus clarki bouvieri*	ID, MT, NV, WY	Fish	BS
Truffle Eater	*Cordyceps ophioglossoides*	CA	Fungi	BS
Truffle, Hypogeous	*Choiromyces venosus*	CA	Fungi	BS
Tryonia, Amalosa (Springsnail)	*Tryonia alamosae*	NM	Crustacean	FE
Tryonia, Amargosa	*Tryonia variegata*	NV	Snail	BS
Tryonia, Grated	*Tryonia clathrata*	NV	Snail	BS
Tuctoria, Greene's	*Tuctoria greenei*	CA	Plant	FE
Tumble-mustard, Long Valley	*Thelypodiopsis ambigua erecta*	UT	Plant	BS
Turk's Head Cactus, Nichol's	*Echinocactus horizonthalonius nicholii*	AZ	Plant	FE
Turtle, Northwestern Pond	*Clemmys marmorata marmorata*	OR	Reptile	BS
Turtle, Painted	*Chrysemys picta*	OR	Reptile	BS
Turtle, Snapping	*Chelydra serpentina*	MT, UT	Reptile	BS
Turtle, Sonoyta Mud Turtle	*Kinosteron sonoriense longifemorale*	AZ	Reptile	C
Turtle, Southwestern Pond	*Clemmys marmorata pallida*	CA	Reptile	BS

Common Name	Scientific Name	State	Class	Status[1]
Turtle, Spiny Softshell	*Trionyx spiniferus*	MT	Reptile	BS
Twayblade, Northern	*Listera borealis*	CO	Plant	BS
Twinpod, Dorn's	*Physaria dornii*	WY	Plant	BS
Twinpod, Double	*Physaria brassicoides*	MT	Plant	BS
Twinpod, Dudley Bluff's	*Physaria obcordata*	CO	Plant	FT
Twinpod, Rocky Mountain	*Physaria saximontana saximontana*	WY	Plant	BS
Twinpod, Salmon	*Physaria didymocarpa lyrata*	ID, MT	Plant	BS
Twinpod, Tufted	*Physaria condensata*	WY	Plant	BS
Vervain, Red Hills	*Verbena californica*	CA	Plant	FT
Vetchling, Grimes	*Lathyrus grimesii*	NV	Plant	BS
Violet, Rock	*Viola lithion*	NV	Plant	BS
Violet, Western (Bog Violet)	*Viola primulifolia occidentalis*	OR	Plant	BS
Vireo, Bell's	*Vireo bellii*	NM	Bird	BS
Vireo, Gray	*Vireo vicinior*	CA, NV	Bird	BS
Vireo, Least Bell's	*Vireo bellii pusillus*	CA	Bird	FE
Vole, Amargosa	*Microtus californicus scirpensis*	CA	Mammal	FE
Vole, Ash Meadows Montane	*Microtus montanus nevadensis*	NV	Mammal	BS
Vole, Hualapai Mexican	*Microtus mexicanus hualpaiensis*	AZ	Mammal	FE
Vole, Mexican	*Microtus mexicanus*	UT	Mammal	BS
Vole, Pahranagat Valley Montane	*Microtus montanus fucosus*	NV	Mammal	BS
Vole, Virgin River Montane	*Microtus montanus rivularis*	UT	Mammal	BS
Wafer-Parsnip, Evert's	*Cymopterus evertii*	WY	Plant	BS
Wafer-Parsnip, William's	*Cymopterus williamsii*	WY	Plant	BS
Wallflower, Coast	*Erysimum ammophilum*	CA	Plant	BS
Wallflower, Menzies'	*Erysimum menziesii eurekense*	CA	Plant	FE
Warbler, Blackpoll	*Dendroica striata*	AK	Bird	BS
Warbler, Lucy's	*Vermivora luciae*	NV	Bird	BS
Warbler, Townsend's	*Denroica townsendi*	AK	Bird	BS
Warbler, Virginia's	*Vermivora virginiae*	ID	Bird	BS
Waterhemlock, Bulb-bearing	*Cicuta bulbifera*	ID	Plant	BS
Water-marigold, Beck's	*Megalodonta beckii*	MT	Plant	BS
Water-starwort, The Dalles	*Callitriche fassettii*	OR	Plant	BS
Water-umbel, Huachuca	*Lilaeopsis schaffneriana recurva*	AZ	Plant	FE
Waterweed, Long Sheath	*Elodea bifoliata*	MT	Plant	BS
Water-willow, Wright's	*Justica wrightii*	NM	Plant	BS
Wavewing, Greeley's	*Cymopterus acaulis greeleyorum*	OR	Plant	BS
Waxflower; Jamesia, Four Petal	*Jamesia tetrapetala*	NV, UT	Plant	BS
Weevil, Rulien's Miloderes	*Miloderes* sp.	NV	Insect	BS
Western Rosinweed, Butte County	*Calycadenia oppositifolia*	CA	Plant	BS
Western Rosinweed, Dwarf	*Calycadenia villosa*	CA	Plant	BS
Western Rosinweed, Hoover's	*Calycadenia hooveri*	CA	Plant	BS
Whale, Blue	*Balaenoptera musculus*	OR	Mammal	FE
Whale, Bowhead	*Balaena mysticetus*	AK	Mammal	FE
Whale, Finback	*Balaenoptera physalus*	AK	Mammal	FE
Whale, Humpback	*Megaptera novaeangliae*	AK, OR	Mammal	FE
Whiptail, Canyon Spotted	*Cnemidophorus burti*	AZ, NM	Reptile	BS
Whiptail, Gray Checkered	*Cnemidophorus dixoni*	NM	Reptile	BS
Whiptail, Plateau Striped	*Cnemidophorus velox*	UT	Reptile	BS
Whitefish, Bear Lake	*Prosopium abyssicola*	ID	Fish	BS
Whitefish, Pygmy	*Prosopium coulteri*	OR	Fish	BS
Whitlow-grass, Aleutian	*Draba aleutica*	AK	Plant	BS

Common Name	Scientific Name	State	Class	Status[1]
Whitlow-grass, Howell's	*Draba howellii*	OR	Plant	BS
Whitlow-grass, Ogilve Mountains	*Draba ogilviensis*	AK	Plant	BS
Whitlow-grass, Standley	*Draba standleyi*	NM	Plant	BS
Whitlow-grass, Tundra	*Draba kananaskis*	AK	Plant	BS
Whtilow-grass, Murray's	*Draba murrayi*	AK	Plant	BS
Wild Ginger, Green-flowered	*Asarum caudatum viridiflorum*	OR	Plant	BS
Wild-rye, Sand	*Elymus flavescens*	MT	Plant	BS
Willow, Autumn	*Salix serissima*	CO	Plant	BS
Willow, False Mountain	*Salix pseudomonticola*	ID	Plant	BS
Willow, Hoary	*Salix candida*	CO, ID	Plant	BS
Willow, Low Blueberry	*Salix myrtillifolia*	CO, NM	Plant	BS
Willow, Netleaf	*Salix reticulate glabellicarpa*	AK	Plant	BS
Willow, Soft-leaved	*Salix sessilifolia*	OR	Plant	BS
Willow-herb, Nevada	*Epilobium nevadense*	UT	Plant	BS
Wirelettuce, Malheur	*Stephanomeria malheurensis*	OR	Plant	FE
Wire-lettuce, Schott	*Stephanomeria schottii*	AZ	Plant	BS
Wolf, Gray	*Canis lupus*	AZ, CO, NM, NV, WY	Mammal	FE
Wolf, Gray	*Canis lupus*	ID	Mammal	FE, XN
Wolf, Gray	*Canis lupus*	MT, OR, UT	Mammal	FT
Wolf, Mexican Gray	*Canis lupus baileyi*	NM	Mammal	FE, XE
Wolverine, North American	*Gulo gulo luscus*	ID, UT	Mammal	BS
Wood-fern, Aravaipa	*Thelypteris puberula sonorensis*	AZ	Plant	BS
Woodpecker, Black-backed	*Picoides arcticus*	ID	Bird	W
Woodpecker, Black-backed	*Picoides arcticus*	MT, OR	Bird	BS
Woodpecker, Hairy	*Picoides villosus*	MT	Bird	BS
Woodpecker, Lewis'	*Melanerpes lewis*	ID, NV, OR, UT	Bird	BS
Woodpecker, Red-cockaded	*Picoides borealis*	NM	Bird	FE
Woodpecker, Three-toed	*Picoides tridactylus*	MT, OR, UT	Bird	BS
Woodpecker, White-headed	*Picoides ablolarvatus*	ID, OR	Bird	BS
Woodrat, Riparian (San Joaquin Valley Woodrat)	*Neotoma fuscipes riparia*	CA	Mammal	FE
Woodrat, Stephen's	*Neotoma stepheni*	UT	Mammal	BS
Woodrat, White Sands	*Neotoma micropus leucophaea*	NM	Mammal	BS
Woodsage, American	*Teucrium canadense occidentale*	ID	Plant	BS
Woody-aster, Orcutt's	*Xylorhiza orcuttii*	CA	Plant	BS
Woolly-heads, Dwarf	*Psilocarphus brevissimus*	MT	Plant	BS
Wooly-star, Brandeegee's	*Eriastrum brandegeeae*	CA	Plant	BS
Woolly-star, Hoover's	*Eriastrum hooveri*	CA	Plant	FT
Woolly-star, Santa Ana River	*Eriastrum densifolium sanctorum*	CA	Plant	FE
Woolly-star, Yellow-flowered	*Eriastrum luteum*	CA	Plant	BS
Woolly-sunflower, Barstow	*Eriophyllum mohavense*	CA	Plant	BS
Woolly-sunflower, Fort Tejon	*Eriophyllum lanatum hallii*	CA	Plant	BS
Wooly-threads, San Joaquin	*Lembertia congdonii*	CA	Plant	FE
Wormwood, Aleutian	*Artemisia aleutica*	AK	Plant	BS
Wormwood, Mystery	*Artemisia biennis diffusa*	WY	Plant	BS
Wormwood, Northern	*Artemisia campestris wormskioldii*	OR	Plant	C
Wormwood, Purple	*Artemisia globularia lutea*	AK	Plant	BS
Wormwood, Yellow-ball	*Artemisia senjavinensis*	AK	Plant	BS
Woundfin	*Plagopterus argentissimus*	AZ, NM,	Fish	FE

Common Name	Scientific Name	State	Class	Status[1]
		NV, UT		
Yampah, Red-rooted	*Perideridia erythrorhiza*	OR	Plant	BS
Yarrow, Cusick's False	*Chaenactis cusickii*	ID	Plant	BS
Yellow Cress, Columbian (Columbia Cress)	*Rorippa columbiae*	CA, OR	Plant	BS
Yellow Cress, Persistant Sepal	*Rorippa calycina*	MT, WY	Plant	BS
Yellow Cress, Tahoe	*Rorippa subumbellata*	CA, NV	Plant	C
Yellowhead, Desert	*Yermo xanthocephalus*	WY	Plant	FT
Yellowthroat, Common	*Geothlypis trichas*	UT	Bird	BS

[1] BS = BLM sensitive species; DM = Delisted species that has recovered and will be monitored for 5 years; C = Candidate species for listing under the ESA; EmE = Emergency endangered species listing; FE = Federal endangered species; FT = Federal threatened species; PE = Proposed for listing as an endangered species; PT = Proposed for listing as a threatened species; W = Withdrawn; XE = Experimental population, essential; and XN = Experimental population, nonessential.
[2] ESU = Evolutionary Significant Unit.



The Bureau of Land Management *Today*

Our Vision

To enhance the quality of life for all citizens through the balanced stewardship of America's public lands and resources.

Our Mission

To sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

Our Values

To serve with honesty, integrity, accountability, respect, courage, and commitment to make a difference.

Our Priorities

To improve the health and productivity of the land to support the BLM multiple-use mission.

To cultivate community-based conservation, citizen-centered stewardship, and partnership through consultation, cooperation, and communication.

To respect, value, and support our employees, giving them resources and opportunities to succeed.

To pursue excellence in business practices, improve accountability to our stakeholders, and deliver better service to our customers.

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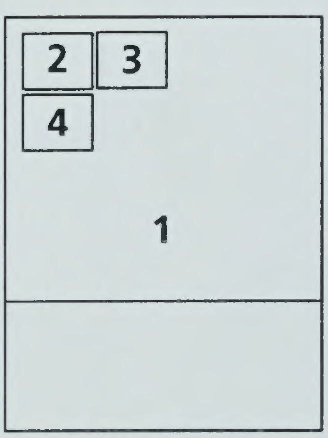

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1. Arrowleaf balsamroot (*Balsamorhiza sagittata*) in bloom near Elko, Nevada (courtesy of Stan White, Bureau of Land Management Volunteer)
2. Helicopter spraying (courtesy of Keith Duncan, New Mexico State University Cooperative Extension Service)
3. All-terrain vehicle spraying (courtesy of L. D. Walker, Bureau of Land Management)
4. Herbicide spraying using a llama (courtesy of Cindy Lair, Colorado State Department of Agriculture)

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